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OUR NATIONAL INLAND WATERWAYS POLICY[1]

Under any circumstances I should welcome the chance of speaking at Memphis in the old historic State of Tennessee, rich in its glorious past and in the certainty of an even greater future; but I especially congratulate myself that I am able to speak here on an occasion like this, when I meet not only the citizens of Tennessee, but many of the citizens of Mississippi and Arkansas and of other states as well; and when the chief executives of so many states are gathered to consider a subject of momentous interest to all. The Mississippi Valley is a magnificent empire in size and fertility. It is better adapted to the development of inland navigation than any other valley in either hemisphere; for there are 12,000 miles of waterway now more or less fully navigable, and the conditions are so favorable that it will be easy to increase the extent of navigable waterways to almost any required degree by canalization. Early in our industrial history this valley was the seat of the largest development of inland navigation in the United States, and perhaps you will pardon my mentioning that the first steamboat west of the Alleghenies was built by a Roosevelt, my great-grandfather's brother, in 1811, for the New Orleans trade, and in that year made the trip from Pittsburg to New Orleans. But from various causes river and canal transportation declined all over the United States as the railroad systems came to their full development. It is our business to see that the decline is not permanent; and it is of interest to remember that nearly a century ago President Madison advocated the canalization of the Mississippi.

In wealth of natural resources no kingdom of Europe can compare with the Mississippi Valley and the region around the Great Lakes, taken together, and in population this huge fertile plain already surpasses all save one or two of the largest European kingdoms. In this empire a peculiarly stalwart and masterful people finds itself in the surroundings best fitted for the full development of its powers and faculties. There has been a great

[1]From address delivered by President Roosevelt to the Deep Waterway Convention at Memphis, Tenn., October 4, 1907.

growth of manufacturing centers in the valley; the movement is good if it does not go too far; but I most earnestly hope that this region as a whole will remain predominantly agricultural. The people who live in the country districts, and who till the small or medium-sized farms on which they live, make up what is on the whole the most valuable asset in our national life. There can be just as real progress and culture in the country as in the city; especially in these days of rural free delivery, trolleys, bicycles, telephones, good roads, and school improvements. The valley of the Mississippi is politically and commercially more important than any other valley on the face of the globe. Here more than anywhere else will be determined the future of the United States and indeed of the whole western world; and the type of civilization reached in this mighty valley, in this vast stretch of country lying between the Alleghenies and the Rockies, the Great Lakes and the Gulf, will largely fix the type of civilization for the whole Western Hemisphere. Already, as our history shows, the West has determined our national political development, and the fundamental principle of present American politics, political equality, was originally a western idea.

The wonderful variety of resources in different portions of the valley makes the demand for transportation altogether exceptional. Coal, lumber, corn, wheat, cotton, cattle—on the surface of the soil and beneath the soil the riches are great. There are already evident strong tendencies to increase the carrying of freight from the northern part of the valley to the Gulf. Throughout the valley the land is so fertile as to make the field for the farmer peculiarly attractive; and where in the west the climate becomes dryer we enter upon the ranching country; while in addition to the products of the soil there are also the manufactures supplied in innumerable manufacturing centers, great and small. Cities of astonishing growth are found everywhere from the Gulf to the Great Lakes, from the Alleghenies to the Rockies; most of them being situated on the great river which flows by your doors or upon some of its numerous navigable tributaries. New mineral fields are discovered every year; and the constantly increasing use of all the devices of intensive cultivation steadily adds to the productive power of the farms. Above all, the average man is honest, intelligent, self-reliant, and orderly, and therefore a good

citizen; and farmer and wageworker alike—in the last analysis the two most important men in the community—enjoy a standard of living, and have developed a standard of self-respecting, self-reliant manhood, which are of good augury for the future of the entire Republic. No man can foresee the limit of the possibility of development in the Mississippi Valley.

Such being the case, and this valley being literally the heart of the United States, all that concerns its welfare must concern likewise the whole country. Therefore, the Mississippi River and its tributaries ought by all means to be utilized to their utmost possibility. Facility of cheap transportation is an essential in our modern civilization, and we cannot afford any longer to neglect the great highways which nature has provided for us. These natural highways, the waterways, can never be monopolized by any corporation. They belong to all the people, and it is in the power of no one to take them away. Wherever a navigable river runs beside railroads the problem of regulating the rates on the railroads becomes far easier, because river regulation is rate regulation. When the water rate sinks, the land rate cannot be kept at an excessive height. Therefore it is of national importance to develop these streams as highways to the fullest extent which is genuinely profitable. Year by year transportation problems become more acute, and the time has come when the rivers really fit to serve as arteries of trade should be provided with channels deep enough and wide enough to make the investment of the necessary money profitable to the public. The National Government should undertake this work. Where the immediately abutting land is markedly benefited, and this benefit can be definitely localized, I trust that there will be careful investigation to see whether some way can be devised by which the immediate beneficiaries may pay a portion of the expenses—as is now the custom as regards certain classes of improvements in our municipalities; and measures should be taken to secure from the localities specially benefited proper terminal facilities. The expense to the Nation of entering upon such a scheme of river improvement as that which I believe it should undertake, will necessarily be great. Many cautious and conservative people will look askance upon the project, and from every standpoint it is necessary, if we wish to make it successful, that we should enter upon it only under conditions which will

guarantee the Nation against waste of its money, and which will insure us against entering upon any project until after the most elaborate expert examination, and reliable calculation of the proportion between cost and benefit. In any project like this there should be a definite policy, and a resolute purpose to keep in mind that the only improvements made should be those really national in their character. We should act on the same principle in improving our rivers that we should follow in improving our harbors. The great harbors are of consequence not merely to the immediate localities, but to immense stretches of country; and the same is true of the great rivers. It is these great rivers and great harbors the improvement of which is of primary national interest. The main streams should be improved to the highest practical degree of efficiency before improvements are attempted on the branches, and work should be undertaken only when completion is in sight within a reasonable time, so that assured results may be gained and the communities affected depend upon the improvements. Moreover, as an incident in caring for the river so that it may become an efficient channel of transportation, the United States Government should do its full part in levee building, which, in the lower reaches of the river, will not only give a channel for commerce, but will also give protection to the adjacent bottom lands.

Immense sums have already been spent upon the Mississippi by the States and the Nation, yet much of it remains practically unused for commerce. The reasons for this fact are many. One is that the work done by the National Government at least has not been based upon a definite and continuous plan. Appropriations by Congress, instead of assuring the steady progress and timely completion of each piece of work as it was undertaken, have been irregular and uncertain. As a direct consequence, far-reaching plans have been discouraged and continuity in execution has been made impossible. It is altogether unlikely that better results will be obtained so long as the method is followed of making partial appropriations at irregular intervals for works which should never be undertaken until it is certain that they can be carried to completion within a definite and reasonable time. Planned and orderly development is essential to the best use of every natural resource, and to none more than to the best use of our inland waterways. In

the case of the waterways it has been conspicuously absent. Because such foresight was lacking, the interests of our rivers have been in fact overlooked, in spite of the immense sums spent upon them. It is evident that their most urgent need is a farsighted and comprehensive plan, dealing not with navigation alone, nor with irrigation alone, but considering our inland waterways as a whole, and with reference to every use to which they can be put. The central motive of such a plan should be to get from the streams of the United States not only the fullest but also the most permanent service they are capable of rendering to the Nation as a whole.

The industries developed under the stimulus of the railroads are for the most part permanent industries, and therefore they form the basis for future development. But the railroads have shown that they alone cannot meet the demands of the country for transportation, and where this is true the rivers should begin to supplement the railroads, to the benefit of both, by relieving them of certain of the less profitable classes of freight. The more farseeing railroad men, I am glad to tell you, realize this fact, and many of them have become earnest advocates of the improvement of the Mississippi, so that it may become a sort of inland seaboard, extending from the Gulf far into the interior, and I hope ultimately to the Great Lakes. An investigation of the proposed Lakes-to-the-Gulf deep waterway is now in progress under an appropriation of the last Congress. We shall await its results with the keenest interest. The decision is obviously of capital importance to our internal development and scarcely less so in relation to external commerce.

This is but one of the many projects which it is time to consider, although a most important one. Plans for the improvement of our inland navigation may fairly begin with our greatest river and its chief tributaries, but they cannot end there. The lands which the Columbia drains include a vast area of rich grain fields and fruit lands, much of which is not easily reached by railways. The removal of obstructions in the Columbia and its chief tributaries would open to navigation and inexpensive freight transportation fully 2,000 miles of channel. The Sacramento and San Joaquin rivers with their tidal openings into San Francisco Bay are partly navigable now. Their navigation should be maintained and

improved, so as to open the marvelously rich valley of California to inexpensive traffic, in order to facilitate both rate regulation and the control of the waters for other purposes. And many other rivers of the United States demand improvement, so as better to meet the requirements of increasing production from the soil, increasing manufacture, and a rapidly growing population.

While thus the improvement of inland navigation is a vital problem, there are other questions of no less consequence connected with our waterways. One of these relates to the purity of waters used for the supply of towns and cities, to the prevention of pollution by manufacturing and other industries, and to the protection of drainage areas from soil wash through forest covering or judicious cultivation. With our constantly increasing population this question becomes more and more pressing, because the health and safety of great bodies of citizens are directly involved.

Another important group of questions concerns the irrigation of arid lands, the prevention of floods, and the reclamation of swamps. Already many thousands of homes have been established on the arid regions, and the population and wealth of seventeen states and territories have been largely increased through irrigation. Yet this means of national development is still in its infancy, and it will doubtless long continue to multiply homes and increase the productiveness and power of the Nation. The reclamation of overflow lands and marshes, both in the interior and along the coasts, has already been carried on with admirable results, but in this field, too, scarcely more than a good beginning has yet been made. Still another fundamentally important question is that of water power. Its significance in the future development of our whole country, and especially of the West, is but just beginning to be understood. The plan of the City of Los Angeles, for example, to bring water for its use a distance of nearly 250 miles—perhaps the boldest project of the kind in modern times—promises not only to achieve its purpose, but in addition to produce a water power sufficiently valuable to pay large interest on the investment of over $23,000,000.

Hitherto such opportunities for using water to double purpose have not always been seized. Thus it has recently been shown that water enough is flowing unused over government dams, built to

improve navigation, to produce many hundreds of thousands of horsepower. It is computed that the annual value of the available but unused water power in the United States exceeds the annual value of the products of all our mines. Furthermore, it is calculated that under judicious handling the power of our streams may be made to pay for all the works required for the complete development and control of our inland waterways.

Forests are the most effective preventers of floods, especially when they grow on the higher mountain slopes. The national forest policy, inaugurated primarily to avert or mitigate the timber famine which is now beginning to be felt, has been effective also in securing partial control of floods by retarding the run-off and checking the erosion of the higher slopes within the national forests. Still the loss from soil wash is enormous. It is computed that one-fifth of a cubic mile in volume, or one billion tons in weight of the richest soil matter of the United States, is annually gathered in storm rivulets, washed into the rivers, and borne into the sea. The loss to the farmer is in effect a tax greater than all other land taxes combined, and one yielding absolutely no return. The Department of Agriculture is now devising and testing means to check this enormous waste through improved methods of agriculture and forest management.

Citizens of all portions of the country are coming to realize that, however important the improvement of navigation may be, it is only one of many ends to be kept in view. The demand for navigation is hardly more pressing than the demands for reclaiming lands by irrigation in the arid regions and by drainage in the humid lowlands, or for utilizing the water power now running to waste, or for purifying the waters so as to reduce or remove the tax of soil waste, to promote manufactures and safeguard life. It is the part of wisdom to adopt not a jumble of unrelated plans, but a single comprehensive scheme for meeting all the demands so far as possible at the same time and by the same means. This is the reason why the Inland Waterways Commission was created in March last, largely in response to petitions from citizens of the interior, including many of the members of this Congress. Broad instructions were given to the Commission in accordance with this general policy that no plan should be prepared for the use of any stream for a single purpose without carefully considering, and so

far as practicable actually providing for, the use of that stream for every other purpose. Plans for navigation and power should provide with special care for sites and terminals, not only for the immediate present, but also for the future. It is because of my conviction in these matters that I am here. The Inland Waterways Commission has a task broader than the consideration of waterways alone. There is an intimate relation between our streams and the development and conservation of all the other great permanent sources of wealth. It is not possible rightly to consider the one without the other. No study of the problem of the waterways could hope to be successful which failed to consider also the remaining factors in the great problem of conserving all our resources. Accordingly, I have asked the Waterways Commission to take account of the orderly development and conservation, not alone of the waters, but also of the soil, the forests, the mines, and all the other natural resources of our country.

Many of these resources which we have been in the habit of calling inexhaustible are being rapidly exhausted, or in certain regions have actually disappeared. Coal mines, oil and gas fields, and iron mines in important numbers are already worked out. The coal and oil measures which remain are passing rapidly, or have actually passed, into the possession of great corporations, who acquire ominous power through an unchecked control of these prime necessities of modern life; a control without supervision of any kind. We are consuming our forests three times faster than they are being reproduced. Some of the richest timber lands of this continent have already been destroyed, and not replaced, and other vast areas are on the verge of destruction. Yet forests, unlike mines, can be so handled as to yield the best results of use, without exhaustion, just like grain fields.

Our public lands, whose highest use is to supply homes for our people, have been and are still being taken in great quantities by large private owners, to whom home-making is at the very best but a secondary motive subordinate to the desire for profit. To allow the public lands to be worked by the tenants of rich men for the profit of the landlords, instead of by freeholders for the livelihood of their wives and children, is little less than a crime against our people and our institutions. The great central fact of the public land situation, as the Public Lands Commission well said, is

that the amount of public land patented by the government to individuals is increasing out of all proportion to the number of new homes. It is clear beyond peradventure that our natural resources have been and are still being abused, that continued abuse will destroy them, and that we have at last reached the forks of the road. We are face to face with the great fact that the whole future of the Nation is directly at stake in the momentous decision which is forced upon us. Shall we continue the waste and destruction of our natural resources, or shall we conserve them? There is no other question of equal gravity now before the Nation.

It is the plain duty of those of us who for the moment are responsible to make inventory of the natural resources which have been handed down to us, to forecast as well as we may the needs of the future, and so to handle the great sources of our prosperity as not to destroy in advance all hope for the prosperity of our descendants.

As I have said elsewhere, the conservation of natural resources is the fundamental problem. Unless we solve that problem it will avail us little to solve all others. To solve it, the whole Nation must undertake the task through their organizations and associations, through the men whom they have made specially responsible for the welfare of the several States, and finally through Congress and the Executive. As a preliminary step, the Inland Waterways Commission has asked me to call a conference on the conservation of natural resources, including, of course, the streams, to meet in Washington during the coming winter. I shall accordingly call such conference. It ought to be among the most important gatherings in our history, for none have had a more vital question to consider.

There is a great national project already under way which renders the improvement of the Mississippi River and its tributaries specially needful. I mean the Panama Canal. The digging of that canal will be of benefit to the whole country, but most of all to the States of the Pacific slope and the Gulf; and if the Mississippi is properly improved, to the States through which it flows. The digging of the Panama Canal is the greatest engineering feat which has yet been attempted on this globe. The work has been going on most successfully and with fewer drawbacks and difficulties than I had dared hope. When under our

treaty with Panama we took possession of the Canal Zone I was confident that we should be able to build the canal, but I took it for granted that we should meet many unexpected difficulties, not only in the actual work, but through, and because of, the diseases which had made the Isthmus a byword of unhealthfulness. The work done in making the conditions on the Isthmus healthy, however, has been so successful that at present the death rate among the thousands of Americans engaged in the canal work is lower than in most localities in the United States. The organization has been perfected, the machinery installed, and the actual work, of the dredges, the steam shovels, and the dirt trains, is going on with constantly increasing rapidity and effectiveness. In the month of September just closed over fourteen hundred thousand cubic yards of material were removed, chiefly from the Culebra Cut—the record removal, two hundred thousand yards better than the August record, of which I spoke the day before yesterday—and if this rate can be kept up, as I believe it will be kept up, the work of digging will be through in half a dozen years. The finishing of the locks of the great dam may take a little longer; but it begins to look as though the work will be completed even sooner than we had estimated.

Remember, gentlemen, that any work like this entails grave responsibilities. The one intolerable position for a self-respecting nation, as for a self-respecting man, is to bluff and then not be able to make good. We have accepted the Monroe doctrine as a cardinal feature of our foreign policy. We have undertaken not only to build but to police and to guard the Panama Canal. This means, unless we are willing to accept the humiliation of being treated some time by some strong nation as a vain and weak braggart, that we must build and maintain our navy at the highest point of efficiency. When the canal is finished our navy can move from one ocean to the other at will; for, remember that our doors open on both oceans. Until then our battle fleet, which should always be kept and maneuvered as a unit, ought now to appear in our home waters in one ocean and now to appear in our home waters in the other. And, oh my friends and fellow-Americans, I most earnestly hope all our people will remember that in the fundamental questions most deeply affecting the life of the Nation there can be no proper division on party lines. Matters of such grave

moment should be dealt with along the lines of consistent and well thought-out policy, without regard to any change of administration or of party at Washington. Such questions as the upbuilding and maintenance of the United States navy, the completion of the Panama Canal in accordance with the plans now being carried out, the conservation of our national resources, and the improvement of the Mississippi River, are not party questions. I am striving to acomplish what I can in such matters as these because the welfare of the Nation imperiously demands the action that I am taking. It is action in the interest of all the people, and the need for it will be as great long after I have passed out of public life as it is now. On these great points that I have mentioned, as on others I could mention, from the standpoint of the Nation the policy is everything, while it is of little importance who carries it out so long as it actually is carried out. Therefore, I hope you will see to it, according to your best endeavor, that the policy is accepted as permanent, as something to be persevered in because of the interest of the whole people, and without regard to any possible political changes.

PRESENT STATUS OF THE PANAMA PROJECT

By Brigadier-General Henry L. Abbot, U. S. A., Retired,

Late member of the Comité Technique, sometime Consulting Engineer of the New Panama Canal Company; and late member of the U. S. Board of Consulting Engineers.

To form an intelligent appreciation of the present status of the work upon the Isthmus one must understand the physical conditions there existing, the character of the project adopted for the canal, the organization under which the work is now in progress, and what has been accomplished. Each will be considered in turn.

When the concessions and property were transferred by the New French Company to the United States, on May 4, 1904, it was unavoidable, before serious work of construction could be inaugurated, that much preparatory work should be undertaken, and that a definite project for the canal should be elaborated and approved by Congress—which latter was not done until June 29, 1906. The actual period of preparation has covered about three years, and it would be easy to show that in general the time has been well spent; but the details of what has been done in advance of the adoption of the final project pertain rather to history than to the present inquiry. It suffices to state that the cities of Panama and Colon, and the Zone itself, have been supplied with potable water and placed in a sanitary condition entirely satisfactory; that the requisite engineering plant and a large force of laborers, some 30,000 men on the canal and railroad, with comfortable quarters and good arrangements for messing have been provided: that much of the Panama Railroad has been double-tracked, and its yards, docks and other facilities largely extended: and, finally, that at the end of March, 1907, when the present canal organization was inaugurated, nearly six million cubic yards had been excavated from the great Culebra cut at an average cost of about 78 cents per yard: about three and a half millions had been dredged, and work on the locks and dams was beginning. Such, in brief, was the status early in the current year. It remains to consider the elements of the problem as now presented.

Physical Conditions on the Isthmus.

There are no mountains properly so called on the general line of the canal; indeed the highest summits of the continental divide in this district hardly exceed 1,500 feet above tide, while at the Culebra where the route crosses it, and where much work has been done already, the original level did not exceed about 345 feet, now reduced to 312 feet by a slight change in line. For about seventeen miles between Bohio and Empire, igneous rock in the form of brechias, or conglomerates, or massive overflows known locally as the rock of Gamboa, lies at or near the surface; but on both the Atlantic and Pacific slopes it is overlain by ancient sedimentary formations of the tertiary period, composed of much softer materials but occasionally traversed by igneous veins. Nearer the coasts ancient and modern alluvial deposits occur. The deep cut between Bas Obispo and the southern terminus of the Culebra lies chiefly in the softer material; its total length hardly exceeds seven miles, and only about one mile of it is really of a formidable character by reason of its height.

Much has been said about danger to the canal from earthquakes, which are popularly supposed to be frequent throughout all Central America. Fortunately the long chains of volcanoes approaching from the north and from the south both deflect to the eastward before reaching the Canal Zone, to appear in the Lesser Antilles. The Republic of Panama lies near the middle of a quiet district between Chiriqui and Tolima, some six hundred miles apart, where no volcanic eruption has occurred since the miocene tertiary, and where such earth movements as do occur are those transmitted with lessened intensity from distant foci of disturbance. Since the foundation of the old city of Panama, in August, 1519, only two earthquakes classed as severe are of record; but one of them, in 1621, is considered as doubtful by M. de Montessus after a discussion of the ancient documents, and in this opinion he is supported by recent local studies. The other, occurring on September 7, 1882, coincided in time with a violent earthquake at Sucia, on the Atrato River, about fifty miles from the Atlantic. It caused some unimportant damage at Panama and on the line of the railroad, but the fact that it did not rupture the exceptionally flat arches of the ruins of the old Santo Domingo Church, burned in March, 1756, demonstrates that no serious injury would have been

done to the massive constructions of the projected canal. These views as to the comparative immunity of the route are supported by recent direct observations covering forty months. Delicate seismographs were established at Panama; and the records, compared with those kept simultaneously at San Jose de Costa Rica under governmental control, showed only four light shocks, as against ninety-one light and thirty-five strong shocks. No route between the oceans—indeed no point on the earth's surface—is wholly exempt from such dangers, but the canal follows the line where exemption seems most probable.

The chief technical difficulty is presented by the Chagres River, whose banks must be closely followed between Gatun and Gamboa, a distance more than half that between the oceans. This turbulent neighbor gives rise to more complex problems than the passage of the mountain ranges which barred the routes of our Pacific railroads,—any engineering project must be adjusted to the terrain, and here the river dominates.

The stream is a typical torrent of the tropics, characterized in nine months of the year by violent freshets, which sometimes, but rarely, develop into destructive floods, inundating the entire valley. The volume at Gamboa may then attain 80,000 feet-seconds; at Bohio, 115,000 feet-seconds; and at Gatun probably 160,000 feet-seconds,—nearly that of the Potomac at Great Falls, Md. If over-generous in the rainy season, the Chagres becomes niggardly in the three dry months, when its flow, largely supplied by ground water, is insufficient to operate a canal with locks. With them storage reservoirs are a necessity. The river has another peculiarity which aggravates the difficulty of its regulation, especially if a sea level solution be contemplated. At Bohio, some twenty-seven miles above the mouth by the course of the stream, the water surface at the extreme low stage is only about a foot above the level of mean tide on the Atlantic coast, where the tidal oscillation is about a foot and a half. Small as this variation is, it causes at such times a three-inch tide at Bohio. But the most important effect of the deficient slope of the bed below that point is to cause a piling up of the water in times of flood, resulting in a maximum rise of some forty feet, which exceeds that at any other point of its entire course and considerably aggravates the problem of regulation unless (as has been done) the dam site be chosen lower on the stream.

The annual flow of the Chagres and its distribution throughout

the different months have important bearings upon the canal problem, and they are now well understood. Daily measurements for seventeen years (fourteen by French and three by American engineers) have been made at Bohio, where the drainage of about 700 square miles passes the station. The average monthly volume during this period is 4,587 cubic feet per second, distributed in the different months in the following percentages of total annual flow. For comparison with streams in the northeastern part of the United States, similar estimates are quoted from "Water Power," by J. P. Frizell, third edition, published in 1906. In the Chagres, although rainfall is the primary cause, ground water has much to do with the progressive changes in volume from month to month, as will appear below:

Percentage of Annual Flow (55,044 Feet-Seconds).

	The Chagres	Northeastern U. S.		The Chagres.	Northeastern U. S.
January	7.0	10	July	9.6	2
February	2.7	14	August	10.7	3
March	1.8	20	September	10.5	3
April	2.6	15	October	12.3	5
May	7.2	10	November	15.2	6
June	7.1	4	December	13.3	8

The sedimentary matter carried by the Chagres varies considerably, being of little importance at low stages, but increasing in freshets and floods. The material is so fine that no delta has been formed at the mouth, but it cannot be ignored in a project for the canal. Sand bars exist, especially in the upper river, where the frequent variations in discharge and the rapid slope of the bed produce a very unusual phenomenon—a complete sorting of the material, some bars consisting of fine sand, others of large pebbles, and others of rocks as large as one's fist. The latter probably move only in the great floods when the absorption of the fall existing in the numerous rapids gives a general quasi-uniform slope to the water surface capable of causing extraordinary velocities.

It is manifest that such a river demands the closest study in order to accommodate the canal in the best possible way to its vagaries. This it has received for many years from the engineers of the French administration, and researches are actively continued

at the present time. All recent results confirm the older conclusions. One of them of a general character is important as bearing on the work of construction. Both the measured monthly discharges and the recorded frequency and heights of the freshets concur in indicating that alternate epochs of large discharge and of small discharge succeed each other at considerable intervals, and that one of the latter is now and has been passing for some ten or eleven years. The last maximum epoch, the first since the construction of the Panama Railroad, occurred during and probably just before the operations of the de Lesseps Company (1881-88); and it should occasion no surprise if its successor should soon make its appearance.

One most fortunate event occurred in last December in the form of an exceptionally large flood, the first since 1893. It had been eagerly awaited for long years by the engineers of the canal; because the standard flood, upon which the hydraulic problem of regulation had been solved, occurred in 1879, before systematic gauging had begun, and its estimated volume had been based upon the known maximum heights attained at a few points, and upon the study of smaller floods measured subsequently. Verification of the estimates as to volume and duration was earnestly desired. The opportunity was afforded by the records secured by Mr. Arango during the flood of 1906. The level attained at Gamboa was only one foot, and at Bohio only seven-tenths foot below the standard flood, and the duration of the dangerous period was several hours less than had been assumed for 1879. The maximum volume fell below the estimated standard by only about 2,600 feet-seconds at Gamboa and 4,700 at Bohio. The previsions of the engineers, which had been claimed by some to be excessive, were thus amply justified.

This recent flood largely exceeded any other which has occurred in the past half century, except that of 1879. The rainfall at its height, following two weeks of heavy downpours, registered about four inches in twenty-four hours. About fifteen miles of the main line of the Panama Railroad were submerged from two to ten feet, the water standing on the track at Matachin five feet deep; two small bridges were carried away and other damages were reported. The material losses in 1879, enhanced at Colon by a destructive tempest from the north, were much larger.

Another feature of this interesting river has been developed by researches covering about nine years, six under French and three under American direction, and both are perfectly in accord. They were designed to check the conclusions based on geologic examination that no serious percolations are to be apprehended from the artificial lakes to be created for the regulation of the Chagres. The climate of the Isthmus, where frost is unknown and where the regular succession of wet and dry months facilitates the study of rainfall and outflow, has been of great assistance. The result demonstrates that the river traversing a densely-wooded region receives large contributions from ground water, in fact fully one-third of the annual rainfall, and hence that no important subterranean outlets can exist for the escape of the canal reserves. This ground water flow amounts to little or nothing in May, at the end of the dry season, but then gradually and uniformly increases until a maximum is reached in November, after which the rains soon begin to diminish, and in February, March and April the stream is fed almost wholly by ground water. The subterranean flow is thus regulated by the successive filling and emptying of a great reservoir formed by the soil, which has little or no outlet but the bed of the stream. Space is lacking here for the details of these researches, but the practical conclusions admit of no doubt.

The climate of the Isthmus is another element which cannot be ignored in considering the problems of the canal. The temperature from month to month hardly varies throughout the year, the annual mean in the shade being about 80° F. The daily range in the interior in the dry months differs but little from 73° F. at 6 a. m. to 89° F. at 1 p. m.; and in the rainy season from 75° F. at 6 a. m. to 86° F. at noon. On the Pacific coast extremes occur a little later, and the range is some 3° less. The mercury when directly exposed to the sun's rays rises, of course, much higher; at Empire, the records show an average of about 106° F. in the months when the sun is far to the southward, and 122° F., or even more, for the months when it is more nearly overhead at noon. Humidity is always excessive, ranging between about 0.80 in the dry months to about 0.87 in the rainy. The uniformity of barometric readings is even more remarkable. During five continuous years at Alhajuela the extreme variation was only 0.44 inch; and at Ancon in 1906 it was only 0.28 inch. Uniformity of high temperature and

excessive humidity are the governing characteristics of the atmosphere, and this, with persons of northern birth, produces lassitude and need of occasional change; but on the other hand the absence of frost will greatly assist the making of concrete for locks, and their practical operation in the passage of ships.

The winds of the Isthmus are usually gentle, ranging from five to eight miles per hour on the Caribbean coast and about the same on the Bay of Panama. There is a noteworthy absence of the hurricanes so common in the West Indies, which here are represented only by what are called "northers" at Colon, occurring at rare intervals, but dangerous at such times to shipping lying at the piers. In the interior very little annoyance from winds will be experienced by vessels in transit.

Rainfall here is more subject to known laws than in temperate regions, being regulated by the annual movement of the sun in declination carrying with it the axis of ascending moist air to be condensed by cold in the upper regions and precipitated in the form of a rain belt oscillating north and south following the sun. In the Canal Zone, lying in latitude 9° north, the sun is at the zenith on April 13, moving northward, and again on August 29, returning southward. This naturally divides the year into dry and rainy seasons, sharply defined. The former extends approximately from the middle of January to the middle of April, the rain belt being then to the south. At this time in the interior, where the heaviest work is required, the monthly downfall averages about one inch, falling in about seven days. The rainy season covers the rest of the year, with a monthly downfall averaging about twelve inches falling in about twenty-one days, but on many of these days the showers are light. Near the Atlantic coast the annual precipitation is about 140 inches, while near the Pacific it is only about sixty inches. In the interior it ranges from place to place between these limits. Experience has shown that this heavy downfall practically reduces excavation output in the rainy season not far from twenty-five per cent, largely by reason of increased difficulty in shifting track and transporting material to the dumps.

The health conditions on the Isthmus are no longer what they were during the construction of the Panama Railroad and the tentative operations of the de Lesseps company. Colonel Gorgas, by practically applying modern sanitary methods, has brought about a

marvelous improvement, and residence in the Zone is now hardly more dangerous than in many localities in the United States. Formerly the yellow fever caused many deaths, although in nowise endemic, as was proved by prolonged disappearances. As in our southern states, it took the form of epidemics caused by importations. The last one occurred in 1905, but was soon suppressed, no case appearing after May, 1906. Out of a total population of 108,-206 persons in the Zone and the cities of Panama and Colon in September, 1907, only 297 deaths from all causes occurred, showing an annual average per 1,000 of 32.93. For the employees of the canal and railroad the corresponding figures in this month were 41,062, and 98, and 28.63. Under the efficient administration of Colonel Gorgas the dreaded tropical diseases of the Isthmus have lost their terrors.

Project Adopted for the Waterway.

It is known to every one that for long years a struggle was in progress in the United States, first as to the route and later as to the type of construction. Both questions have been happily settled, and it is only needful at the present time to consider the project formally adopted by the government.

The line followed by the canal measures about 40 miles between shore lines, and 49.35 miles between 41-foot contours in the Bay of Limon and the Bay of Panama. Both ports have met the demands of commerce since the earliest dates, and no engineering difficulty will be experienced in adapting them to the largest class of modern shipping. It is well to remember in what follows that the general direction of the route is from northwest to southeast, Panama lying some twenty miles to the eastward from Colon.

At Gatun, three miles from the shore of the Bay of Limon, the canal reaches the Chagres River. Here will be constructed three duplicate locks, with lifts of 29 feet, and a dam to create a lake having 165 square miles of surface and rising 85 feet above mean tide level (which is the same in both Limon and Panama Bays). This great lake forms the summit level of the canal. Its depth on the ship route will be never less than 42 feet, and for sixteen miles its navigable width will generally exceed half a mile. In the next nine miles the width gradually diminishes to 800 feet, 500 feet, and 300 feet; and at Las Cascades, where for only seven miles the route

becomes properly speaking a canal, the depth at the normal stage is maintained at 45 feet and the width at bottom at 200 feet. At Pedro Miguel, thirty-two miles from Gatun, a descent of 30 feet is made to a second lake (Sosa) by one duplicate lock. This lake, raised 55 feet above mean tide, is formed by two principal dams, of which the most important one is situated near La Boca, where are also two duplicate locks to conduct to the Pacific. The distance across the lake is five miles, making the total distance between ocean shore lines only forty miles, of which more than three-quarters lie in navigable lakes.

As intimated above, six locks are required, three at Gatun to reach the great lake; one at Pedro Miguel, to descend to Lake Sosa; and two at La Boca to reach Panama Bay. Their dimensions, required by the law of Congress to accommodate vessels "of the largest tonnage and the greatest draft now in use, and such as may be reasonably anticipated," are, subject to revision, to be 1,000 feet long, 100 feet wide, and 40 feet deep. These dimensions under the law much exceed what was previously considered to be necessary to meet the probable needs of commerce for at least half a century. Thus the Comité Technique proposed 738 feet, 82 feet, and 32.8 feet; and the Isthmian Canal Commission of 1899-01 recommended 740 feet, 84 feet and 35 feet. Numerous borings and repeated investigations have demonstrated that all of the locks, of the dimensions now proposed, will rest upon rock of such character that it will furnish a safe and stable foundation, and there is no reason to apprehend difficulties or dangers in the passage of shipping. Practical experience with large locks, large ships, and an immense traffic on our great St. Mary's waterway, which carries annually, although blocked by ice in the winter, more tonnage than all four of the other most important ship canals of the world taken together, is conclusive as to safety of passage. With substantial piers of approach, and suitable guard gates, and by moving the vessels by stationary power other than their own, dangers to locks and to shipping in transit are as nothing compared to those frequently encountered by the latter on the ocean.

Gross misrepresentation, largely from interested parties and enemies of the canal, has been rife in the public press concerning the dam at Gatun. This construction is neither more nor less than a large engineering work involving no problems which may not be

solved by ordinary methods of procedure. The cross section has been slightly changed, and the upstream slope is to be more gradual than originally proposed. It is a technical matter which the public may safely leave to the engineers in charge. The same may be said of the Pacific dams, which are of much smaller dimensions than the one at Gatun.

It remains to consider how the vagaries of the Chagres and the question of water supply in the dry season are treated in the adopted project. In this connection an important and gratifying discovery has been made since the plan was adopted. The earlier projects had contemplated a dam on the river at Bohio, and detailed contoured surveys below that point were lacking. When the Board of Consulting Engineers decided upon a lower location there was no time to make such surveys before adjournment. Consequently the estimate of the area to be submerged by the dam at Gatun at normal lake level had to be formed from the best maps available; and it was taken at 110 square miles, care being given to avoid any over-valuation, since such would tend to exaggerate the capacity of the lake for absorbing the floods and for storing the reserves. A recent contoured survey has shown the true area at 85 feet elevation, to be 165 square miles; and it is not without interest to see how the change affects the anticipations of the Board.

Beside affording a wide and unobstructed route for shipping in transit, the lake will have two important duties: to absorb in part the excess of volume in floods, and to store the reserves for the three months of deficient river flow. The first requirement was estimated at a rise of two feet above normal lake level; and the second was fixed at a subsidence of three feet, in order to maintain a navigable channel without excessive height in lock walls and lock gates, or unnecessary excavation in shallow parts of the lake. The total oscillation from the normal level of 85 feet above tide was thus restricted to 5 feet. The corresponding figure for the lake projected above Bohio was, in the project of the Comité Technique, 5.7 feet, and in that of the Isthmian Canal Commission of 1899-01, 10.4 feet. Naturally the less the oscillation the simpler will be the problems at the locks. The larger lake is a great advantage, permitting any available funds to be devoted to widening rather than to deepening the navigable channels. This matter will bear a little study.

The rise in floods will depend upon the area of the lake and

the permissible rate of outflow. Since the latter is independent of the area of the lake, and the estimated area is now known to be increased 50 per cent, the computed oscillation for flood regulation is reduced to a little over one foot instead of two, the rate of outflow remaining unchanged. This gain, however, is apparent rather than real since the contemplated encroachment, at the end of the rainy season, of one foot on the two feet, with a view to increase the volume available for low water reserves, would no longer be judicious, especially as the largest floods always occur in November and December.

The correction to be made for storage oscillation is not so simple. Three elements are affected: surface area, loss by evaporation and loss by infiltration. The first of these losses is dependent not only on lake area but also on the rate of evaporation; and both area and rate have been affected by new measurements since the report of the Board was submitted. Since no local observations as to evaporation from exposed water surfaces were then available, the rate assumed (0.24 inch per twenty-four hours) was intentionally liberal. This estimation was based on records kept on Lake Nicaragua, with allowance for the "uncertain data as to lake area below Bohio." Actual measurements have recently been made by Mr. Arango on a reservoir at Bas Obispo, giving average monthly losses per twenty-four hours since December 1, 1906, of 0.135 inch, 0.167 inch, 0.181 inch, 0.212 inch, 0.216 inch, 0.151 inch, 0.104 inch, 0.102 inch, 0.116 inch, 0.112 inch, 0.095 inch, and 0.120 inch. The true local values per day are thus 0.20 inch in the three deficient months, 0.12 inch in the rainy months, and 0.14 inch annually. These figures are consistent with the Lake Nicaragua observations (0.19 inch annually), since the annual rainfall in the basin of that lake is about 65 inches, to compare with about 90 inches at Bas Obispo; and the humidity there should be somewhat less and the evaporation somewhat larger. The Board's estimate of the loss by evaporation in the three deficient months was measured by a flow during that period of 710 cubic feet per second. By the correction of the rate this is reduced to 592 feet-seconds for a lake of 110 square miles, which is raised by the increase in area to 888 feet-seconds.

Any estimate of loss by infiltration must at best be based on suppositions. It has been stated above that the Chagres is largely

fed by ground water at all seasons, except at the very end of the three dry months; a fact which is inconsistent with serious loss by seepage or escape by subterranean flow. The Board's estimate is represented by a flow of 77 feet-seconds. Since such losses in this valley must be restricted to a few points of escape, it is conservative to assume that adding fifty per cent to the lake surface will not more than double this loss, raising it to 154 feet-seconds. The aggregate of the two losses is thus raised from 787 feet-seconds to 1,042 feet-seconds, an increase of about 33 per cent. To this must be added the Board's estimates for leakage at gates, 250 feet-seconds; for lighting, power, etc., 200 feet-seconds; and, finally, for contingencies, 200 feet-seconds, making a grand total of 1,692 feet-seconds to cover all losses in the dry season other than those for lockage. This total deducted from that contributed by the stream itself in the three deficient months, joined to the volume three feet deep stored in the lake below elevation 85, will represent the volume available for passing vessels through the locks.

The *minimum* flow of the stream at Gatun during the ninety days of deficient flow was estimated by the Board at 1,250 feet-seconds (the average being 2,360); this was based on ample data available at Bohio, and upon over one hundred gaugings of the Isthmian Canal Commission of 1899-01, on the tributaries below that point, including an exceptionally dry year. Ignoring the insignificant reduction of lake surface produced by a subsidence of 3 feet, the storage volume above elevation 82 feet is represented by 13,800 million cubic feet instead of 9,198 million figured upon the old area. Adding these two sources of supply and deducting the losses (1,692 feet-seconds) indicated above, there will remain available for lockage a revised volume of 10,360 million cubic feet. How many transits will this permit in the ninety days of deficient flow?

The following lockage estimates are based on the dimensions now proposed, namely, with a depth of 40 feet, a usable length of 1,000 feet and a width of 100 feet, both of the latter dimensions exceeding those favored by the members advocating a lock canal, who in the text of their report used smaller figures (40 x 900 x 95 feet). To save needless waste of water, and what is even more important, *needless time in lockage*, interior gates were admitted on the Pacific slope, affording a usable length of 550 feet, but not

on the Atlantic slope, by reason of the three locks in flight; and in traffic computations it was assumed that eight-tenths of the vessels would use the smaller chambers. Upon these suppositions the volume now to be expended for one daily transit of the canal would be, if using only the large chambers, 71.2 feet-seconds, and if using both on the Pacific slope only, 58.2 feet-seconds. Making the computation with these values, and comparing the results with the old figures, the gain resulting from the new data over that available to the Board is, using only the large chambers, 18.7 daily transits to compare with 13.7; and using both chambers as indicated above, 22.9, as compared with 17.1. The project is thus rendered more attractive than was supposed before the discovery that a larger lake area is available; but if desired the showing may be still further improved by introducing the system of intermediate gates in the triple flight of locks at Gatun, placing the small chambers at the down-stream ends of the upper and middle locks and at the up-stream end of the lower lock. By proper operation of the intermediate gate in the middle lock this location virtually reduces the flight of three locks to a single lock separated from a flight of two by a pseudo-canal about 465 feet long. The manœuvres at a transit will be the following:

Suppose the last ship had ascended by the large chambers, leaving them all full; a ship descending by the small chambers after moving into the middle lock will close the middle gate behind it before descending into the lower lock, thus leaving the little pseudo-canal full. It will remain full, no matter how many ascents and descents be made by the small chambers, provided only that the gates be manipulated properly. If, on the other hand, the last ship using the large chambers had descended, leaving them all empty, the first ship to make use of the small chambers will draw from the summit level a full large chamber lockage with which not only to pass but also to permanently fill the pseudo-canal about 465 feet long. This small extra expenditure occurring but rarely, need not be considered in the computations, being much more than covered by the allowance of 200 feet-seconds for contingencies. Adopting this system at Gatun as well as upon the Pacific slope, the lockage volume for one daily transit of the canal, using small and large chambers in the ratio of eight to two, will be 46.3, to compare with 58.2 feet-seconds, when only the Pacific slope is equipped

with intermediate gates. This will further increase the number of daily transit during the dry season to 28.7, to compare with 22.9 when large chambers only are used in the Gatun flight, and to compare with 18.7 without small chambers on either slope.

But it must be noted that these figures by no means limit the possible traffic. It will be easy when more is demanded to store from surplus flow in the rainy season a large reserve in an upper lake formed by the dam projected at Alhajuela (capacity 11,300 million cubic feet, estimated cost $2,400,000), supplemented, if needful, by others on the Trinidad and Gatuncillo. This available volume is represented by the *minimum* annual flow of the Chagres at Gatun, 5,730 feet-seconds as adopted by the Board upon trustworthy records covering fourteen years, the corresponding average flow being 8,173 feet-seconds. In making the computation, losses by evaporation and infiltration in the upper lake must be included, its area being 13.5 square miles. The recently measured rate of annual loss by evaporation (0.14 inch per twenty-four hours) is applied to both lakes; the loss by infiltration in the upper is placed at 10 feet-seconds, proportioned to its area; the other figures above remain unchanged. Such a computation will show that the water supply is ample to permit annually 59.3 daily lockages, using the large chambers only; 72.7 using the smaller as proposed on the Pacific slope; or 91.2 using them on both slopes. These figures demonstrate that the Chagres will meet all possible needs of the canal, and that the only limit to traffic is fixed by mechanical delays in passing ships. The Board with intermediate gates on the Pacific slope figured on twenty-six daily transits, corresponding to an annual traffic of about forty million tons, but this might be increased at any time by adding new locks.

In fine, the adopted project offers easy lake navigation for about three-quarters of the entire distance between the oceans, and meets all the prospective needs of commerce. The delays in passage inherent to a restricted route will be limited to the deep cut at the Culebra, only about seven miles in length, and if desired the entire transit can be made in a single day without encroaching on the hours of darkness. Such advantages as compared with the conditions of any economically practicable route at sea level are cheaply purchased by the passage of a few modern locks.

Present Organization on the Isthmus.

The spring of 1907 may properly be regarded as the end of the preparatory period, inasmuch as the technical plan of the canal or even whether it should be of sea level or lock type, had only been decided by Congress and approved by the President in the preceding June. At this date the status of the work was highly satisfactory. The chief engineer, Mr. John F. Stevens, had created an efficient organization, comprising a working force on the canal and railroad of about 25,000 men, well lodged and fed, with a good supply of modern plant; Colonel Gorgas had accomplished wonders in the sanitation of the Isthmus; and cordial relations had long been established with the government of the republic. The time had come when the work of construction could be pushed judiciously. The President considered that under these conditions the Commission should move its headquarters to the Canal Zone, and as both Mr. Shonts and Mr Stevens had tendered their resignations he radically reorganized this Commission. When Senator Spooner drafted the bill which ultimately became the law authorizing the purchase of the concessions and property of the New Canal Company, he provided that the work should be executed under the War Department, the intention being that the immediate direction should be vested in the Corps of Engineers of the Army, upon which such duties in this country usually devolve; but in the discussion before the Senate this provision was changed, and an Isthmian Canal Commission of seven members was substituted. The present Commission, fourth of the name, combines the two ideas. Its personnel is thus constituted under the immediate direction of the Secretary of War, Judge Taft:

Lieutenant-Colonel George W. Goethals, Corps of Engineers, Chairman.

Major David DuB. Gaillard, Corps of Engineers.

Major William L. Sibert, Corps of Engineers.

Rear Admiral H. H. Rousseau, Civil Engineer, U. S. Navy.

Hon. Joseph C. S. Blackburn.

Colonel William C. Gorgas, Medical Dept. U. S. Army.

Mr. Jackson Smith.

Colonel Goethals, who is also chief engineer, has general charge and direction of construction and engineering. Major Gaillard has special charge of the department of excavation and dredg-

ing. Major Sibert, of the department of lock and dam construction, also including the division of meteorology and river hydraulics. Admiral Rousseau, of the department of municipal engineering, motive power and machinery, and building construction. Mr. Blackburn, of civil administration; Colonel Gorgas, of sanitation; Mr. Smith, of labor, quarters and subsistence. Mr. Joseph Bucklin Bishop is secretary of the Commission.

Since this last reorganization, which dates from April 1, 1907, the detail of officers of the Corps of Engineers for duty on the Isthmus has been resumed. On August 1, Major Edgar Jadwin was assigned to the department of excavation and dredging, as division engineer of the Chagres division; and on the same day Major Chester Harding was assigned to the department of lock and dam construction, as division engineer of the Gatun division. On October 16 Captain Horton W. Stickle, and on November 12 Captain George M. Hoffman, were detailed for like duty. These two departments, upon which devolves all work of canal construction proper, are divided locally into nine divisions under the two commissioners in charge.

On July 1, by direction of the President, the duty of purchasing engineering materials and supplies for the Commission was placed under the supervision of the Chief of Engineers of the Army. By his order Major Harry F. Hodges was assigned to this duty on August 15, and officers and agents of the department were directed to make such purchases, inspections and shipments in the vicinity of their several offices as he may request in the name of the Chief, and to render duly authenticated vouchers to him for payment. Under this plan the force at the Washington office of the Commission is largely reduced, and in procuring the needed supplies advantage is taken of existing agencies widely distributed over the United States. The system of accounting is also simplified; the papers now go direct to the Auditor of the War Department, instead of passing to him through an intermediate auditor of the Isthmian Canal Commission.

On March 22, 1907, a new code of civil procedure was ordered by the President to take effect within the Zone on May 1. The chief justice of the supreme court is Dr. F. Mutis Durán, and the two associate justices are Messrs. H. A. Gudger and Lorin C. Collins.

The importance of continuing the French system of river and climatological records is appreciated. The work, assigned to the supervision of Major Sibert, remains organized as a division under Mr. Ricardo M. Arango, who has been in charge since it was created in June, 1905. The fluviograph records with occasional gaugings are continued at Alhajuela, Gamboa and Bohio; and quite recently measures have been taken to determine the contributions of the two important tributaries below Bohio, the Trinidad and Gatuncillo, checked by fluviograph records and gaugings near Gatun. The deficient slope in the lower Chagres at low stages, and the tidal changes of level, although fortunately moderate in the Caribbean Sea, make the determination of discharge at Gatun at such times a delicate one—as has always been the case at Bohio, but to a much less degree. Arrangements have recently been made to put the system of river gaugings to practical use in excavation by sending warnings, twenty-four hours in advance, of interruptions to be expected from freshets or floods coming from the upper river.

Regular observations upon evaporation were inaugurated in December, 1906, at Bas Obispo, supplemented by wind records both as to velocity and direction. An old masonry pool or tank fully exposed to sun and wind was utilized for this purpose, thus making sure that the results will not suggest underestimates of loss in the reserves stored in the prospective lakes. The records to date have been given above.

Two new seismographs of latest type have been ordered recently to replace the original French instruments, in use at Ancon since September, 1900. One will be placed at a position where it will be exposed as little as possible to earth tremors caused by blasting, and the other at a central location to be used in studying the rate and laws of transmission of such earth waves.

To continue the local rain records, which in this district of heavy downfall have practical importance in connection with current works of excavation as well as with studies for river regulation, twelve stations along the line of the canal are now equipped with rain gauges of approved patterns.

In addition, four complete meteorological observatories, provided with instruments like those in use at weather bureau stations in the United States, have been established at Naos, Ancon, Bas Obispo and Cristobal. Here regular observations are made of

temperature, barometric pressure, relative humidity, and clouds, together with any special phenomena. At the coast stations tidal records and water temperature are added. In brief, provisions for continuing and extending the scope of the elaborate French observations have received attention.

Potable water is now furnished from four main storage reservoirs,—the Mount Hope near Colon, the Rio Grande for the Pacific slope, the Camacho and the Gatuncillo for the interior,—together with auxiliary pumping stations supplied by them and by dams on the Caribali and Frijoles rivers.

Progress in Work of Construction.

Between the transfer of the property to the United States on May 4, 1904, and April 1, 1907, in other words during the period of the first two Commissions charged with works of construction, there has been removed, measured in place and at a cost for steam shovel work of about 78 cents per cubic yard:

	Cubic Yds.
At Culebra Cut, by steam shovels:	
In 1904	243,472
In 1905	914,254
In 1906	2,702,991
In 1907, to April	2,021,132
Total	5,881,849
At Gatun, by steam shovels, beginning October, 1906	244,495
At La Boca, by steam shovels, beginning March, 1907	3,905
Total steam shovel work	6,130,249
At Colon, outside canal prism, by dredges	1,732,712
At La Boca, outside canal prism, by dredges	1,956,895
Total by dredges	3,689,607
Grand total excavation	9,819,856

The total estimated excavation remaining on April 1, 1907, to complete the canal, including both steam shovel work and dredging, was:

	Cubic Yds.
Canal prism	101,050,000
Lock sites	7,965,000
Regulating works and diversion channel	2,150,000
Construction channels, Cristobal and Panama	3,350,000
Total	114,515,000

This estimate includes 500,000 cubic yards to completely remove all threatening material at the old Cucaracha slide, which caused the most annoyance in the days of the de Lesseps Company. It lies on the east side of the cut about half a mile from Gold Hill, and to the southward from the deepest part of the excavation. In October, under the heavy rains, an earth movement toward the cut began at a rate of about fourteen feet per day, and three steam shovels were put to work night and day to hold it in check; this soon produced the desired effect.

On July 1, 1907, there were in service on the Isthmus 63 steam shovels, of which 3 were of the 45-ton type, 28 of the 70-ton type with 2.5-yard buckets; and 32 of the 95-ton type, the latter equipped with 5-yard buckets and capable of handling a rock of over ten tons in weight; thirty-seven shovels were under contract. Their chief duty has been and will be at the Culebra division, where the distance of the dumps reduces the output. Thus in this month 132 locomotives were at work there on over 106 miles of track; and the aggregate length of holes drilled for blasting was 19.38 miles. In September this length was 20.5 miles, and 107 tons of explosives were used. On September 17, when 39 shovels were at work, the daily average (eight hours) was 875 cubic yards. On the same day four shovels at the Gatun lock site average 1,305 cubic yards each. These were record outputs. A single shovel in eight hours has registered at Bas Obispo 1,954 yards; at Culebra, 2,188 yards, and at Pedro Miguel, 3,040 yards. This was in November.

The question of labor has presented a different phase since the American occupation. Under the old sanitary conditions experience demonstrated that dependence must be placed upon the negroes of the West Indies, as it appeared that they alone could perform hard labor safely under the tropical sun. Their labor was of a very inferior character, and under the new sanitary conditions it has been found that Spanish, Italian and Greek laborers are not only much superior but also show a less death rate. Over 5,000 of them were employed in November. The negroes suffer much from pneumonia, from which the whites are exempt, or nearly so. At the end of October 25,915 men were working on the canal and 6,139 on the Panama Railroad, the aggregate rolls showing a much larger number. The idea of completing the work by contract, although seriously entertained prior to the appointment of the present Commission, seems now to be definitely abandoned.

Work on the canal is divided locally between two divisions, forming the Atlantic and Pacific approaches, the Culebra division including the cut through the continental divide, the Chagres division extending thence to deep water in Gatun Lake, and the Gatun division including the dam and locks. Each will be considered in turn.

At both of the ocean approaches considerable dredging will be necessary. The Colon division extends from the Gatun locks to Mindi and thence to deep water in the Caribbean Sea; here some 21,000,000 cubic yards are to be removed, of which about 3.7 millions are rock. One 16-inch suction dredge, two 5-yard dipper dredges, and one French ladder dredge are at work, and a second French ladder dredge is undergoing repairs for this purpose. They are served by four French self-propelling hopper barges, known as "Clapets," and one tug, together with six new steel hopper barges requiring to be towed by the others.

The La Boca division extends from the locks at Pedro Miguel to deep water in Panama Bay; and here some 15,000,000 cubic yards are to be removed, of which about one-twentieth is rock. The dredging plant now here consists of two French ladder dredges and one 5-yard dipper dredge served by eight "Clapets;" three steel hopper barges to be towed by the latter are under contract. The old French material has been repaired and is reported as doing excellent service; two of the ladder dredges removed 287,107 cubic yards during October. The new sea-going suction dredge "Culebra" is expected to arrive from Baltimore, via the Straits of Magellan, in January, 1908—a voyage of 12,000 miles. Its consort, "Ancon," which will work pumping material on the Gatun dam when the site has been prepared, has made a fine record in Limon Bay, where it arrived in last August. In September it removed and dumped in the sea off Toro Point 260,773 cubic yards, a volume equivalent to the output of 14 steam shovels served by about 30 trains of 16 cars each; thus 57 men operating the dredge did the work of about 1,500—but working of course in much softer material.

The heaviest excavation is concentrated in the Culebra division between Bas Obispo and Pedro Miguel, a distance of nine and a half miles. This is now organized in five sections of about equal length, each under a local superintendent, reporting through two intermediate engineers to the commissioner in charge, Major Gail-

lard. Throughout this distance a 10-inch pipe line main has been extended, with 6-inch and 4-inch leads running into the canal prism. Air pressure is maintained by twelve compressors, each having a capacity of 2,500 cubic feet per minute, at 100 pounds pressure, all feeding into the main. This supplies power to the rock drills and stone crushers on the line, and to the coal chutes, and to the machine shops at Las Cascadas and Pedro Miguel. A recent invention of Mr. Bierd, late manager of the Panama Railroad, has introduced an improvement in the mode of transferring the soil to the dumps. Under the heavy rainfall during nine months of the year the constant shifting of track incident to the work has always caused much loss of time. Instead of the old operation of prying up the rails with screw jacks, shifting the ties, and then spiking the track down again, the device of Mr. Bierd shifts the whole at once. It consists of a double-drum hoisting engine with a horizontal and a vertical boom, all mounted on a flat car. It is capable of throwing 5,400 lineal feet of track a distance of 9 feet in eight hours, representing the work of five or six hundred men under the former system. It is operated by three mechanics and six laborers. As this kind of work never ceases, the saving both of time and cost is important. The use of mechanical unloaders also greatly expedites work. A record is reported when a single unloader served by 28 white men and 43 laborers and firemen disposed in eight hours of the material, 5,000 cubic yards, brought by 16 trains.

The Chagres division, so-called, extends from the point where the river first strikes the canal to deep water in Gatun Lake. Here the excavation will approximate to 13,000,000 cubic yards, of which about 5,000,000 are rock. The width of the channel for shipping gradually widens as the deep lake is approached, and crosses the present bed of the river over twenty times. In the northern portion the latter will not require excavation, but the banks throughout form detached peninsulas which must be removed. The rock and earth nearby will be excavated with steam shovels, and the remaining earth will be dredged after the lake begins to rise. Work has been started at three points already. It is here that freshets will cause most annoyance. The old French diversion channels to the southward have been considerably extended, and more work of this kind is in progress.

The following figures show the monthly progress in excava-

tion since the last reorganization of the Canal Commission. At the Culebra in September about five-sevenths of the output were classed as rock.

Output in Cubic Yards in 1907.

Month.	By Steam Shovels.					By Dredges near		Total.
	Culebra.	Gatun.	Mindi.	Chagres.	La Boca.	Colon.	La Boca.	
April	879.527	103,459	....	....	1,756	69,889	104,855	1,159,486
May	690,565	70,528	....	....	762	133,847	122,157	1,017,659
June	624,586	75,013	....	....	4,907	124,118	131,580	960,204
July	770,570	74,165	731	....	13,772	109,922	108,338	1,077,498
August	786,866	105,223	15,257	2,820	15,865	209,554	168,284	1,303,869
September	753,468	123,738	28,837	23,746	12,806	420,842	161,350	1,524,787
October	834,499	177,013	41,078	25,627	7,108	426,282	357,122	1,868,729
November	790,632	162,622	40,003	44,044	8,190	427,572	365,423	1,838,486
Total	6,130,513	891,761	125,906	96,237	65,166	1,922,026	1,519,109	10,750,718

Before the type of the canal was decided (June, 1906) it was impossible to begin work on the locks and dams,—an unfortunate circumstance, because here will now probably be found the chief delays in opening the route to traffic. Operations under the supervision of Major Sibert have, however, started vigorously at Gatun. At the end of August, six steam shovels were excavating at the lock sites and spillway, and railway trestles were erecting and preparations were making for dumping and sluicing materials at the dam. So soon as the pipe line dredges and the plant for mixing concrete can be installed progress will be rapid. Suitable stone and sand for concrete have been located near Porto Bello; also material for cement of the highest grade at a cost not exceeding $1.34 per barrel, in case unreasonable prices should be demanded for supplying it by sea. To reduce expense the idea has been suggested of importing cement clinker to be ground on the Isthmus. Work on the lock and dam sites at La Boca has also been inaugurated actively.

The Panama Railroad is in busy operation. During last June, in addition to the 1,284 commercial trains, 3,874 construction trains were reported as transporting canal materials. As many as 196 trains occasionally passed a single point on a single day. The wear and tear of the hard service upon the cars, loaded often with huge rocks by steam shovels and discharged mechanically at the dumps, demands continual repairs, and the shops at Gorgona,

Empire, and Paraiso are under constant pressure. In June work was begun simultaneously at seven different points on the new permanent location of the railroad; about 10,000,000 cubic yards of fill in excess of excavation will furnish dumps for material from the canal prism, as the lake will cause important changes in the line.

But, it may be asked, how about finances? The total outlay needful for opening a governmental route for shipping between the Atlantic and Pacific Oceans, via the Isthmus, is naturally classed under two distinct categories—the technical cost of constructing the canal, and certain collateral expenses of ownership and control, such as for right of way, for Zone government, for sanitation, including that of the cities of Panama and Colon, to be repaid ultimately, and for the commercial operation of the Panama Railroad. These several items are often improperly blended in one, and the daily press is already beginning to claim that nearly the whole of the estimated cost of constructing the canal has been expended already. The truth will be understood from the following statement.

The total expenditures which are properly chargeable to technical canal construction are shown in the following table, based on official statements in the *Canal Record*:

	To Dec. 31, 1906.	To June 30, 1907.
For material and supplies	$3,449,022.96	$3,649,665.13
For general administration	1,124,226.55	1,403,557.68
For construction and engineering	9,729,554.98	15,594,834.17
For plant	12,138,852.17	18,484,300.74
Total since transfer	$26,441,656.66	39,132,357.72

The aggregate outlay for all expenditures, including right of way, during these two periods was respectively $84,449,000.32 and $98,285,110.37. The gross error of charging aggregate outlay to canal construction proper is thus apparent. The question remains, what is the proper standard for judging whether or not the actual work of construction is progressing in a satisfactory manner from a financial point of view.

In the act approved June 29, 1906, Congress specifically indorsed the project submitted by the members of the Board of Consulting Engineers favoring the lock type of canal, for which the

estimate was $139,705,200. This estimate includes no part of the outlay (approximately $16,000,000) prior to the rendition of their report (January 10, 1906), and expressly excludes all future costs of sanitation and of the Zone government. Furthermore, the unit prices were based on a 10-hour day, which had always ruled on the Isthmus, and to which the adoption of an 8-hour day has added 20 per cent in so far as the cost of labor is involved. Thus it appears that, even omitting this last increment of the estimate, only about $10,000,000 should be considered as expended upon the adopted project on December 31, 1906, and only about $23,000,000 on June 30, 1907. In other words, at the latter date there remained of it unexpended about $117,000,000. Wage rates ruling higher than those under the direction of the private French companies, and much larger and more expensive locks than were contemplated by the project as submitted, may enhance the estimated cost; but there is no indication that there will be a serious deficit.

In fine, an era of rapid progress has been inaugurated under an efficient organization, with every promise of success, and the expenditures have been kept within reasonable limits. It would still be premature to predict any exact date of completion, but there is no reason to apprehend needless or long delay. The estimate of the Consulting Engineers reporting the project (but with locks of smaller dimensions) was nine years, dating from the beginning of active prosecution of the work. Nearly one year of the nine has already passed, and any reduction of this estimate will reflect credit on the canal administration.

Note.—The important announcement has just been made that the President, upon the recommendation of Colonel Goethals, has approved a radical change in the plan of the canal near the Pacific coast, by suppressing the projected Lake Sosa and transferring the two locks in flight from La Boca to Miraflores, thus locating the latter about four miles inland and connecting them with the ocean by a channel at sea level about 500 feet wide. This was the disposition adopted by the engineers of the New Panama Canal Company, and it is decidedly an improvement, since it not only largely reduces the cost but also places the locks in a position much less exposed to bombardment by a hostile fleet. Numerous test pits at Miraflores demonstrate that solid rock foundations exist for the locks at that locality, and the construction of two large dams becomes unnecessary.

LEGISLATIVE PROGRAM CONGRESS SHOULD ADOPT FOR IMPROVEMENT OF AMERICAN WATERWAYS

By Joseph E. Ransdell, LL.D.,

Member of the Rivers and Harbors Committee of Congress from the Fifth Louisiana District, and President of the National Rivers and Harbors Congress.

There has been much discussion about the improvement of the waterways of the United States during recent years, and great and general interest has been aroused on the subject. A number of waterway associations have been formed to press upon Congress the importance of specific projects; and though local in character, many of them represent very large sections and have gathered into their ranks great numbers of men and much capital. Among the most prominent of these associations are: The Western Waterways Asociation, which aims to unite in a concentrated effort for the common weal all the streams of the Mississippi Valley; the Lake Carriers' Association, which carefully watches all lake interests; the Interstate Mississippi River Levee Association, which looks after the levees of that river from Cairo to the Gulf; the Ohio Valley Improvement Association, whose object is to deepen the Ohio River to nine feet from Pittsburg to Cairo; the Upper Mississippi River Improvement Association, which wishes to see good navigation on the father of waters from St. Louis to St. Paul; the Lakes-to-the-Gulf Deep Waterway Association, which proposes to connect Lake Michigan and the Gulf of Mexico by a channel of fourteen feet; the Missouri Valley River Improvement Association, which expects to have not less than eight feet and hopes to have twelve feet in that great stream from its mouth to Omaha; the Interstate Inland Waterway Association, which seeks to join the Mississippi River and the Rio Grande by a nine-foot canal, linking together the various waterways along the coasts of Louisiana and Texas; the Columbia River Association, which hopes to overcome the obstacles to navigation in that mighty river by a canal and locks at The Dalles and by rock dredging above; the Atlantic Deeper Waterways Association, which advocates a continuous inland route for our naval and merchant ships from Boston to Jacksonville, Fla., thereby avoid-

ing all dangers of the open ocean, and which hopes ultimately to cross the Florida peninsula and skirt the Gulf coast to New Orleans; the Tennessee, the Cumberland, the Ouachita, the Red, the Trinity, the Chattahoochee, the Cape Fear rivers associations, and many others.

In addition there has been the most vigorous and determined effort on the part of maritime interests in the great seaport cities, like Philadelphia, New York, Boston, Baltimore, Norfolk, Savannah, Tampa, Mobile, New Orleans, Galveston, Los Angeles, Oakland, Portland, and Seattle.

All these associations have labored with much energy and with more or less success for their own particular projects without any concert of action; and it was to bring about a united action of all waterway interests that the National Rivers and Harbors Congress was organized in the fall of 1901 and reorganized on its present basis in January, 1906. This association is composed of large numbers of individuals, corporations, commercial organizations, and waterway associations from thirty-three states, and it is in every sense of the word *national.* It does not advocate the improvement of any particular project, but seeks to unite all friends of waterways in an effort to have Congress adopt a definite policy that will provide for the complete improvement within ten years of every worthy and deserving water course on our seaboards, lakes, and interior. *It stands for a policy, not a project.* Its slogan at the great reorganizing convention of January, 1906, in Washington, D. C., was: "An annual rivers and harbors bill carrying at least fifty million dollars:" and again that slogan was repeated at the much greater convention at the nation's capital in December, 1906, while Congress was in session. Largely as the result of sentiment aroused through its efforts, and the splendid co-operation of all other waterway associations and interests, the greatest rivers and harbors bill in our history was enacted in June, 1907. This association will hold another great convention at Washington in December, 1907 (before this article is published), and again it will stand for "An annual rivers and harbors bill carrying at least fifty million dollars."

These river and harbor bills for the past ten years were enacted by Congress triennially: in 1896, 1899, 1902, and 1905. Then, through the united efforts of all our waterway associations and their friends, came the bill of 1907, at the end of *two* instead of

three years. The next convention of the National Rivers and Harbors Congress will insist in the strongest possible way upon *a bill every year,* and will do its utmost to have one enacted next spring at the first session of the Sixtieth Congress. *The annual feature of these bills is regarded as of paramount importance.*

What is the reason for all this agitation and interest? Is it sentimental or is it founded on solid business principles? Undoubtedly on the latter. There is no sentiment about it. The people are very much in earnest. They have ascertained by experience and study that transportation by water is not only much cheaper than by rail, but also much quicker. When freight is loaded in boats on lakes, canals or rivers it moves promptly at a speed of from five to ten miles an hour to its destination, where it is quickly discharged, and the boat started on another trip. When loaded on cars, it frequently remains on a sidetrack for some time, and after reaching its terminus, the cars are again sidetracked and used for days and weeks as storage warehouses. The best authorities say that the average movement of freight by rail in our country is only twenty-five miles per day—only about one mile an hour. I have never seen statistics as to the movement by water, but anyone familiar with the enormous commerce on the Great Lakes, where ten-thousand-ton ships make the round trip from Buffalo to Duluth and return—two thousand miles—every eight to nine days, carrying heavy loads each way, can see that the movement there is considerably over 200 miles a day.

At my home, Lake Providence, La., on the banks of the Mississippi, 400 miles from New Orleans, we have large steamers, and also the railroad, but we never think of shipping bulky articles by rail that can come or go by boat. Cotton is our principal product, and we ship it to New Orleans with the certainty that it will reach there and be in the consignee's hands within three days. If sent by rail, it would be big luck to have it reach the consignee in ten days. *The delivery by boat in three days is certain and by rail in ten days is most uncertain.* I do not think sufficient stress has been laid upon the greater rapidity of freight movements by water than by rail, and invite a study and comparison thereon. It is the old story of the race between the tortoise and the hare. The former won in spite of his slow movements because he kept going. And the boats win for the same reason. They do not slumber on side tracks,

as the hare and the railroad, but keep moving like the patient tortoise and win every time.

As to the relative cost by the two methods, there can be no difference of opinion. The Interstate Commerce Commission reported that the average cost of moving freight by rail in 1906 was *7.48 mills per ton per mile.* The statistical report on the lake commerce for 1906 by Colonel Davis, U. S. E. C., shows it cost to move over 51,000,000 tons through the Sault Ste. Marie Canal last year *.84 of one mill per ton per mile, or one-ninth of the average rail rate.* Major William L. Sibert, now a member of the Panama Commission, for years United States Engineer at Pittsburg, and one of the most accomplished members of the engineer corps of the army, estimates that in 1905, in spite of the unsatisfactory condition of the Ohio River, it cost to move freight from Pittsburg to Louisville .76 of one mill per ton per mile, or one-tenth the average rail rate, and from Louisville to New Orleans .67 of one mill per ton per mile, or one-eleventh of the rail rate. From the best information I can get after a careful study of the subject, I am convinced that *waterway transportation in this country, under favorable conditions, costs only about one-sixth as much as the average cost by rail.*

The above remarks apply to the lakes and rivers and furnish unanswerable arguments for their improvement; but there are just as good reasons for giving our harbors the greatest available depth and placing them on a par with the great foreign ports which receive our splendid commerce. The larger the ship the greater its carrying capacity and the cheaper its rates of freight. Vessels drawing twenty-eight to thirty-two feet and carrying eight to twelve thousand tons can and do carry freight very much cheaper than those drawing twenty-two to twenty-four feet and carrying three to four thousand tons. The ocean rates to-day on the immense steamers plying at our great harbors, which have been deepened to thirty and more feet, are from one-third to one-fourth the rates of twenty-five years ago, when steamers drew only twenty-two to twenty-three feet; and this saving of 300 to 400 per cent in transportation charges is directly due to the improvement of these harbors. Our government never made a wiser expenditure of its funds. The farmer on the western plains and the cotton grower of the South get the direct benefits of these cheap rates, for his produce is worth on his farm its price at Liverpool or Antwerp less the cost of trans-

portation from the farm to those great markets. Every citizen of the Union is benefited. *Practically all our waterway expenditures have been profitable investments. They have returned in reduced freight rates to the American people from 100 to 200 per centum every year.* And yet while appropriations for most purposes of government have been liberal, those for waterways have been stingy and unbusinesslike in the extreme. During our entire history as a nation, to the close of the last fiscal year, on all our waterways of every sort, including those in far away Hawaii, the total expenditure was only $523,330,232; yet we gave the navy during the past five years $490,199,715. *Nearly as much to the navy in five years as to rivers and harbors during the 118 years of our national existence!*

For the five years ending June 30th last all our seaboard and lake harbors, our lakes, rivers, and canals received an average annual appropriation of only $23,425,131.30—less than 3 per cent of the total expenses of government, and a sum entirely inadequate to their merits and needs. The December convention of the National Rivers and Harbors Congress will insist that this appropriation shall hereafter be *not less than fifty million dollars every year.*

The rivers and harbors act of last session carried an appropriatian of $34,631,612 in cash, and authorized contracts to the amount of $48,834,526, making a total of $83,466,138. Under the authorization clause, various works will be placed under contract and will be paid for from year to year as appropriations are hereafter made by Congress. In some instances it will be seven or eight years before these contracts are completed, hence some of the sums authorized in this bill will not be actually appropriated for several years.

This bill was the wisest and most businesslike rivers and harbors bill ever enacted in our country. It provided all sums necessary for the completion of some most important works, notably at the harbors of Boston and Baltimore, the channels at the mouths of the Mississippi and Columbia rivers, the new lock at Sault Ste. Marie, and the new channel in the Detroit River. These six projects required $24,426,194 to complete them, and the total was carried in the bill. Work was already in progress, under the act of 1905, at Boston and Baltimore, and on the Mississippi and Columbia rivers, but the Sault lock and the Detroit River project were entirely new, and the amount they received was $12,870,950. These six great and deserving projects are now out of the way, and need no considera-

tion in future bills. Let us compare the wisdom with which they were handled in the bills of 1905 and 1907 with some other waterway projects.

We undertook to improve the Harlem River in New York City, within the shadow of Wall Street, in 1878, twenty-nine years ago, on a plan estimated to cost $2,700,000. During those twenty-nine years about $1,350,000 have been appropriated and spent, and the work is only about one-half finished. The commerce on the Harlem River last year was 9,998,021 tons, valued at $270,210,309. At the present rate of appropriation it will require another twenty-nine years to complete the project.

About twenty-three years ago we began a project for six-foot slack-water navigation on the Warrior and Tombigbee rivers in Alabama to connect with as rich coal mines as there are on earth and to supply cheap coal to the whole Gulf coast, to our navy, and to the great ocean fleet of that section. At first the project was estimated to cost $3,000,000, but subsequently the plan was changed and the estimated cost increased to $6,000,000. After twenty-three years it still remains far from completion.

In 1875-76, some thirty-two years ago, a project providing for a six-foot slack-water navigation on the Ohio was adopted and work begun thereon. It has proceeded with a snail's pace. Out of fifty-two locks and dams provided for in this project only six have been completed and four others are in process of construction. The project has been changed to a nine-foot depth instead of six, and the estimated cost of completion is $63,000,000. If this gigantic and most meritorious work is continued at the same rate as for the past thirty-one years, it will not be finished by the close of this century. It is true that a little better progress has been made during the past seven years, and at the present rate we may hope to see the Ohio canalized in about fifty years.

These are striking examples of the extreme slowness and unbusinesslike way in which river and harbor works have been carried on. It was not the fault of the rivers and harbors committee. They did as well as they could with the limited amounts at their disposal. Public sentiment did not seem to be with them in the past, and they could not provide the large sums necessary to push meritorious works to speedy completion. And yet the clamor from many communities was so great that they could not avoid making

partial appropriations for prosecution of projects which could not be entirely finished, although they realized how much wiser it would have been to confine their efforts to fewer works and finish them as they went along. This policy of completing old projects before undertaking new ones was to a great extent applied in the act of 1907, and is much wiser.

Now what should be the legislative program that Congress should adopt for the improvement of American waterways? In my opinion, *one that will provide for the proper improvement within the next ten years of all waterway projects along the seaboard, the lakes, and the interior rivers that are really worthy of it, and whose improvement seems warranted by prospective benefits to commerce.* I fix ten years as the period because:

First. The cost of these improvements will be considerable—probably half a billion dollars for the projects already surveyed, which amount would require an appropriation of fifty millions a year for that period.

Second. The character of the work in most cases is such that it must proceed slowly, and even if the total sum were available it would require about ten years to finish many of the greater projects. Some of them are fairly comparable in difficulty of detail and execution with the new Erie and Panama canals, and the engineers of those two great works estimate for their completion at least ten years from inception.

Third. The most ardent enthusiast of waterways is willing to admit that in practical government its various branches should move along "pari passu," and all he expects is a reasonable legislative program which places waterway improvement on a parity with other government works.

Now would it be unreasonable to expend fifty millions, or even one hundred millions, a year for improving our waterways, materially benefitting commerce, reducing freight congestions and cheapening freight rates, so that every citizen of the Union would feel its good effects? By no means. It would be most reasonable and wise. Let us institute a few comparisons on which to base an opinion. For the five years ending June 30, 1907, fortifications received an annual appropriation of $6,761,489, nearly one per cent of all expenses of government; the army received $80,509,480, or about 10 per cent; the navy, $98,039,942, or about 12 per cent; and pen-

sions, \$140,851,836, about 17 per cent; while rivers and harbors received an average of only \$23,425,121.30 a year as above set out, or less than 3 per cent. Commerce is surely as important as war; and as we are now giving to war and its rewards—fortifications, the army, the navy, and pensions—\$336,168,748 a year—over 40 per cent of the expenses of government—and only about 3 per cent to rivers and harbors, surely we can afford to give to our waterways for commerce at the very lowest calculation at least fifty millions, or 7 per cent. If we made it one hundred millions it would be only 14 per cent of our annual expenditures and still not be on a par with those made for war.

How shall we secure this program? The present method of passing rivers and harbors bills every two or three years, which in many instances makes only partial provision for specific projects and does not commit or bind succeeding Congresses to complete them, is lacking in that continuity of plan and purpose essential to success. This is forcibly illustrated by the cases of the Harlem, the Warrior-Tombigbee, and the Ohio Rivers above cited, and there are a great many others exactly similar. The last bill, as stated, was a vast improvement in this respect and made definite provision for the final completion of six great projects. If we could have such a bill every year as that of last June, each providing for the completion on the continuous contract method of several projects, the work would be well in hand very soon, and we could expect the consummation of our hopes within a few years.

I am strongly of the opinion that for the present the best plan for Congress to pursue is to pass a rivers and harbors bill at the coming session carrying in cash and authorizations from fifty to sixty million dollars and making provision:

First. For the completion of several of the more worthy projects under way, whose aggregate cost will not exceed one-third of the bill; say about eighteen to twenty millions.

Second. For the active prosecution on a generous scale of other great works now under construction, whose total cost is too great to permit of provision for completion in one bill.

Third. Adopting plans for and beginning work on some very important new projects not yet adopted; and

Fourth. Ordering surveys for proposed projects of much apparent merit.

I would like to see the completion of as many projects as possible definitely provided for in this bill and the work placed under continuing contract, so that no change of administration or policy could jeopardize the success of a work or indefinitely delay it, after it had once been adopted and begun, as was the case with the Harlem, the Warrior-Tombigbee, and the Ohio Rivers, as explained above.

It would not be feasible without a complete change in the present methods to provide in one bill for the completion of colossal projects like the Ohio River, which will cost over $60,000,000, or the lakes to the Gulf deep-waterway, which will cost much more than the Ohio; but if the bill of next spring definitely adopts the plan for nine feet from Pittsburg to Cairo and makes an appropriation of two and a half millions in cash and five millions in authorizations for the completion of six or seven designated locks and dams on the Ohio, and does as well for the lakes to the Gulf deep-waterway, it would place those two truly great projects on a fairly safe basis, and reduce to a minimum the chances of further delay in their completion.

The same would be true of other projects of great magnitude and cost. They could not be fully provided for, but might be adopted as a whole and good round sums be appropriated to prosecute the work thereon. The rivers and harbors bill of the following year could make further provision for them, and in a few years they would be finished. Of course this theory is based upon the idea *that we are to have an annual rivers and harbors bill in the future, and that it is to carry an average of at least fifty million dollars every year.* If we are to follow the past method of a bill every two or three years, I see no hope for the speedy improvement of our great internal river systems. The harbors and connecting channels on seaboards and lakes will be promptly finished in the future just as they have been in the past, for *they are railroad terminals, but our rivers which are railroad competitors* will not be completed under the present methods within any reasonable period of time. *We must change the method. We must pass rivers and harbors bills every year, and they must carry at least two and a half to three times as large appropriations as in the past. That is the only sure plan, in my judgment—a rivers and harbors bill every year carrying not less than fifty million dollars.*

Transportation is one of the most important questions in the commercial world, and its importance will increase with the growth of wealth and population. Quick and easy transfer and exchange of commodities between different communities is the very life of trade. The cotton grower and lumberman of the South, the grain and meat farmer and lumberman of the West, must send their bulky products to our populous middle and eastern sections and to Europe, receiving in exchange innumerable articles of manufacture, etc. Large numbers of people are constantly moving from place to place, and the mail must be carried with rapidity. The more enlightened and civilized a people becomes the more complex and important are their transportation problems. If all communication with the outside world were cut off from New York City for a week and no food supplies were sent in by water, rail, or earth roads, many people would starve. During the past two years the whole country has been aroused on this subject as never before. Many communities have suffered terribly because a lack of transportation facilities prevented them from moving their commodities. Congress has passed the rate bill, and many state legislatures have enacted laws intended to benefit transportation. Everybody is talking about the subject in some form. Many people think repressive legislation against the railroads will solve it, and others that a complete and thorough development of our waterways would be the panacea for all our transportation ills. None of these people are entirely right, and all have more or less right on their side. One feature of the question is admitted by all and that is its *national character. Nature recognized no state lines in laying out her mighty waterways, and man had as little regard for them in constructing railroads.* Our waterways and railroads are interstate. They extend far beyond the confines of states and should be controlled by the nation rather than by the states.

In my judgment the great importance of this subject warrants the creation by the next Congress of a department of transportation, with full charge of all matters relating to highways, railroads, and waterways. Its chief should be a Cabinet officer—the Secretary of Transportation—and his duties should be limited to subjects connected with transportation.

At the present time the Interstate Commerce Commission which executes our laws relating to public carriers is an independent

body, not connected with any of the departments. Waterway improvements are under the War Department, and are an incident or a side issue not naturally connected with the main business of that great department; and such meager legislation as we have on the subject of highways is executed by the office of good roads of the Agricultural Department. If all these matters were consolidated in one department their importance would be greatly emphasized and they would receive more consideration at the hands of Congress. How can the Secretary of War, with the manifold and difficult duties imposed upon him, be expected to give much attention in Cabinet council, in his reports to Congress, and elsewhere to the *needs of a side issue like waterways?* How can the Secretary of Agriculture insist upon good roads legislation when purely agricultural subjects make such a drain upon him? And what Cabinet officer is there to handle railroad questions? Let us create this department of transportation by all means. It would have plenty to do and would not be exceeded in importance and beneficent effects by any of the older departments.

Pending action on this department, I sincerely hope the coming session of Congress will create a *national* waterways commission similar to the *internal* waterways commission appointed by the President last spring. It should be required to study the waterways of America on seaboard, lake, and interior, and also those of the Old World, with a view to advising Congress how to establish the best and most comprehensive system of water transportation for our country. In doing this our principal waterways should be visited and carefully inspected; experts and business men should be advised with; and all scientific knowledge availed of. The commission should visit and study on the spot the waterways of Europe and elsewhere, so as to get the benefit of all the world's experience on this subject. And the result of its studies and conclusions should be submitted to Congress. Its powers should be limited to obtaining information in regard to waterways, together with the allied subjects of forest preservation and irrigation, and giving advice concerning them to Congress. If the department of transportation is created, this commission should be one of its important bureaus.

To sum up, I would say that the legislative program which Congress ought to adopt at its next session for the improvement of American waterways should be:

First. The prompt passage of a rivers and harbors bill carrying in cash and authorizations not less than fifty million dollars.

Second. The creation of a national waterways commission to study our waterways and advise Congress thereon.

Third. The creation of a department of transportation with control of all matters relating to highways, railroads, and waterways.

THE USE AND DEVELOPMENT OF AMERICAN WATERWAYS

By Honorable Francis G. Newlands,
United States Senator from Nevada, and Vice-Chairman of the Inland Waterways Commission.

The Inland Waterways Commission is the outgrowth of an agitation which has been conducted for some time, particularly in the Mississippi Valley, for the improvement of our waterways. The President was urged to exercise his constitutional power of making recommendations to Congress, and, pursuing his usual method of first exhausting investigation, appointed an executive commission with a view to gathering into one body a number of men who, either in legislative or in administrative work, had acquired experience in the problems relating to the waterways of the country.

Appointment of the Commission

As chairman of this commission the President selected Honorable Theodore E. Burton, of Ohio, who, as the head of the Rivers and Harbors Committee of the House of Representatives, had discharged the duties of that important position with rare intelligence, thoroughness, and public spirit. He also appointed two United States Senators, Honorable William Warner, of Missouri, and the writer; another member of the House of Representatives, Honorable John H. Bankhead, of Alabama (the leading minority member of the Rivers and Harbors Committee of the House), who has since become senator; and five members of the executive department of the government. These scientific members are: General Alexander Mackenzie, Chief of the Engineers Corps of the Army; Dr. W. J. McGee, a scientist and naturalist connected with the Bureau of Soils in the Department of Agriculture; Mr. Frederick H. Newell, Chief of the Reclamation Service; Mr. Gifford Pinchot, Chief of the Bureau of Forestry; and Mr. Herbert Knox Smith, Chief of the Bureau of Corporations. The President reserved the right of adding to the commission, in the future,

certain transportation experts; and it is possible that the commission may, before its work is completed, take up in the broadest way the whole question of transportation.

Purpose of Its Appointment

The duty imposed upon this commission was to investigate the use of water, not only for navigation, but also for all other purposes, with a view to recommending to the President a full and comprehensive plan for the development and utilization of all the natural resources of the country relating to water. Its primary purpose was to facilitate water transportation, upon which the prosperity of the country so largely depends. We have been for some time engaged in the consideration of questions relating to railways and we are now about to enter upon the related question of waterways.

Work Performed by the Commission

Since its appointment the commission has been hard at work upon the problems assigned to it. An organization was effected in Washington, on April 29, 1907. Early in May the commission took a trip down the Mississippi River from St. Louis to the gulf and studied the problems of the lower part of that river. In September, a part of the commission visited the Pacific Coast and inspected the Sacramento and San Joaquin rivers in California and the Columbia River in the Northwest. Beginning September 21, the entire body started on a tour of the Great Lakes, embarking at Cleveland and ending at Duluth. Passing from Duluth to St. Paul by rail, the journey was resumed down that river on board a government boat and continued to Memphis, the President joining the party at Keokuk. After the Memphis convention, most of the members of the commission proceeded to Kansas City, and from that place made a tour of inspection down the Missouri River to its mouth. In these various tours, covering thousands of miles, daily meetings were held at which government engineers and other experts were examined and much testimony taken relative to the conditions and needs of the rivers.

Besides attending the convention at Memphis, the commission was also represented at the Irrigation Congress at Sacramento, California; the Transmississippi Congress at Muskogee, Oklahoma;

the Upper Mississippi Convention at Moline, Illinois; at the Atlantic Deeper Waterways Conference, in Philadelphia, late in November; the recent congress of the National Drainage Association, in Baltimore, and the National Rivers and Harbors Congress, in Washington, which closed a few days ago. On November 25, the commission again convened in Washington, and have ever since been busy considering their recommendations. The President, in his message to the First Session of the Sixtieth Congress, stated that he would transmit his recommendations regarding the waterways to Congress after receiving the report of the commission. The work thus far performed is highly instructive and important; but until their report is formulated and made public, what I shall say upon the subject must be regarded as only the expression of my individual views.

Importance of the Subject

The transportation question is the most important question of the day, and the reason that it has suddenly (and somewhat unexpectedly to many of us) become of such pressing importance just at this time is because the railway service of the country has practically broken down. Whilst the railway development of the country has astonished the world, and whilst we have to-day more than half the railway mileage of the world, yet that machinery has proven inadequate to meet the demands of the production of the country. Years ago the railways were competing with the waterways and practically drove them out of business. But the efforts of the railways to monopolize the carriage of cheap natural products, carried in other countries by water, has resulted in congestion of traffic and a virtual breaking down of the entire transportation system; and it is essential that we shall take immediate steps to supplement our railway system by a complete system of waterway transportation. Everywhere else in the world water transportation is an important factor in both domestic and foreign commerce. Germany has perhaps the most perfect system of transportation in the world. Her rivers have been artificialized from source to mouth and they are supplemented by a system of canal, rail, and ocean transportation which, combined, give that country a transportation machinery unequaled anywhere in the development of domestic and foreign commerce.

However much we may rely upon the railways for quick transportation of persons and of products, it is clear that the rivers should also be used; that they should be properly artificialized; that their beds should be made stable and their courses sure for the transportation of bulky merchandise. This class of traffic has long occupied too large a proportion of the available capacity of the railroads, to the detriment of other more valuable products and even to the injury of life and limb. Even the great railway managers, such men as Mr. Hill, Mr. Harahan, Mr. Finley, and others are urging the development of the inland waterways as supplementary to the railways. Only a few years ago Mr. Hill is said to have declared that water competition could not exist and that, if he were given the money with which to build a double-track railway beside the proposed enlarged Erie Canal, he would turn the canal into a lily pond. It will be remembered also that with regard to the Mississippi River he declared it could never be made an efficient instrument of commerce until its bottom had been lathed and plastered. But the views of these men are changing, and changing because they realize that their railways have been overtaxed and that they must either expend vast sums of money in their improvement or call in the aid of the waterways. Mr. Hill estimates that it will cost, within the next five years, I believe, five and one-half billion dollars to put the railroads in condition to meet the requirements of the country's traffic. This does not appear to be an over-estimate when we remember that the railroads of the country to-day are capitalized at about fifteen billion dollars, and that there is little double track, although every railroad in the country ought to be double-tracked.

A Comprehensive Plan Necessary

I assume that the country will not be disposed to enter upon the work of improving the inland waterways unless a plan is presented which will fairly meet the requirements of the whole country. The movement represents a policy, not a project. It seems improbable that any particular river, such as the Mississippi, will be fastened upon and pushed forward, without some assurance that all the other rivers which require improvement will also be taken up under a comprehensive plan—one involving, ultimately, the highest possible development of all the waterways of the country. It was

doubtless with this thought in mind that the President appointed the commission, and it was doubtless with a view to the formulation of such a plan that he called in the members connected with the Engineer Corps of the Army, the Reclamation Service, the Forestry Service, and the Bureau of Soils. There is practically no difference of opinion, I apprehend, as to the desirability of improving the inland waterways of the country. The public attention is arrested and I never knew the people to be more interested or united. The important thing, now, is to give effective direction to this aroused public sentiment by explaining the true scope of the subject and the importance of scientific legislation for carrying out the comprehensive plans which, alone, will make the undertaking successful. It is possible that the whole question will not be solved for some time, for the reason that Congress rarely takes the initiative; it follows public opinion, rather than leads it. It is fortunate, therefore, that these questions are now being discussed in the various conventions and conferences held throughout the country, and it is important that every man who has a thought of value upon the subject should express it.

Scope of the Work

It is impossible to enter, with hope of success, upon comprehensive plans for the improvement of our inland waterways, without taking into consideration the related questions of forest preservation and restoration, of the irrigation of arid lands, of the reclamation of swamp lands, of bank protection, of clarification of streams, and of other kindred matters.

It is necessary to preserve the forests of the country from the destruction which threatens them, not only because our timber supply is diminishing, but because forests are natural conservators of moisture and aid in the gradual distribution of the waters to the streams and rivers that flow into the lakes and the ocean. When an area of land is denuded of its forests, the waters falling upon it rush off in torrential streams, causing destructive floods and soil waste; but the forest absorbs moisture like a sponge and gives it out gradually to the springs and streams through the season of drought, thus aiding in the maintenance of a stable channel.

So also with the question of the irrigation of the arid lands on the headwaters of our inland rivers. The cultivation of the

vast areas on the upper reaches of the western tributaries of the Mississippi involves the construction of great reservoirs for the storage of water, which is caught while the snows are melting and later on let out through canals upon the plains, to meet the demands of the growing crops. These fertile plains drink up the moisture and become themselves great storage basins which return the water by seepage at the time when it is most needed for the maintenance of a channel in the navigable rivers below.

Thus, both forestry and irrigation are essential to the prevention of floods and of soil waste and to the maintenance of a stable channel for navigation—to say nothing of the vast money value or the great sum of human happiness involved in the possession of great forests and vast areas of productive irrigated plains. For the purpose of navigation it is of the very highest importance that there should be a stable channel, one of standard depth; not a variable channel, forty feet deep at one time and one foot at another; not a channel deep in one place and shallow in others owing to the interposition of shoals and quicksands; but one of standard depth, which will accommodate vessels of standard draft, just as there is a standard gauge for railroads. Anything which will retard the flow of the water during the period of flood and make it available in time of drought will, of course, increase the stability of the channel. And thus it is that the questions of forestry and irrigation become the first importance in connection with the problem of the inland waterways.

Few of us realize, as we ought, that the soil of our continent is being washed away and that the bottoms of the navigable rivers themselves are drifting slowly into the gulf and the ocean. The trouble with the Passes at the mouth of the Mississippi is that a great delta has been built up there, like the delta upon which the City of New Orleans stands, where there is now a depth of twelve hundred feet of alluvial soil which has been deposited by that river. It is not impossible that, in time, the gulf might be turned into a continent by this process.

Closely related to the prevention of soil waste is the matter of the clarification of streams; for every grain of sand in these rivers is a tool of destruction when directed against the river's banks, while clear water cuts the banks but little. The Yellowstone, as its name indicates, is pouring into the Missouri immense volumes of sand,

and the Missouri is pouring into the Mississippi vast quantities of alluvial deposits, every grain of which is both a tool for the destruction of the banks and an obstruction to navigation when deposited in shoals and sandbars. The rivers are also the sources of water supply for domestic purposes to cities and towns, and must be purified and made fit for consumption and kept clear of the filth and sewage of cities.

The reclamation of swamp lands must also be considered. Their reclamation means not only the addition of large and fertile areas to the productive resources of the country, but also the control of the streams themselves. These low lands lie at the foot of the rivers, whose waters naturally spread out wastefully in swamps and bayous. The channels fill up and become shallow because there is no current to carry away the sediment; but when confined in comparatively narrow channels by means of levees the water is thereby raised to a higher level and its current is quickened and becomes an efficient power for carrying away the sediment and scouring the bottoms of the rivers, and thus creating a channel of sufficient depth for the purpose of navigation. So that we have also inseparably connected with the question of navigation the related questions of swamp-land reclamation and bank protection.

All these uses of water are important; it is difficult to say which is the most important. But, assuming that the transportation of products is as important as their production, it is clear that for the proper development of our inland waterways we must embrace in one comprehensive plan the treatment of our forests, the irrigation of arid lands, the reclamation of swamp lands, and other related matters. In doing this, vast water-power can be developed, and this power must be saved from the control of trusts and monopolies and care taken to direct its use in the interest of the entire people. It is estimated that, on many of our navigable rivers, the power which can be developed in this way will be sufficient to pay the entire cost of the improvement of the streams.

Can the Waterways be Restored?

The outline which has been given, based upon the requirements of the Mississippi River, is merely an illustration of what is required on the Pacific Coast rivers and, in less degree, on the rivers of the gulf and the Atlantic Coast. The business question before

us is whether we can restore these waterways as a part of the efficient machinery for the country's transportation. Many doubt it, and I must confess that when I went down the Mississippi, last summer, and traveled for miles without seeing a single boat, I was inclined to doubt it, also. There were a few tow-boats, but the river towns were neglected, the wharves rotting, and the river fronts largely occupied by the tracks of the railroads, whose trains of cars, running at frequent intervals along the banks, showed how thoroughly they had absorbed the commerce of the region.

These conditions seemed to be due to two causes: The terrific competition of the railroads, which have made a practice of underbidding the waterways during the navigation season and afterward raising their rates; and also to the failure of the government to provide and maintain a stable, navigable channel. I am also of opinion that the railroads have been somewhat influential in obstructing legislation for the improvement of our waterways, but I believe they now see that this was a mistaken policy.

I have no doubt, myself, about the policy of restoring the commerce of our inland waterways, but I think it is likely to be a difficult task. One difficulty will be in providing facilities for assembling and distributing the products to be carried on the rivers. The terminal facilities at the towns on the rivers are now very poor, when they are not entirely in the hands of the railroads; and terminal facilities mean little in themselves unless the connecting lines of railroad are able and willing to take goods from the waterways and distribute them in the interior. The railroads have, as one of the chief elements of their strategic strength, the ability to assemble commerce in every part of the country and to carry it on cars of standard gauge to any other part of the country; whereas the river carriers are, at present, circumscribed in their efforts by the limits of the rivers themselves.

It is therefore necessary that the railroads shall be brought into the most intimate relations with the river carriers, so that the one system will supplement and aid, not injure, the other. We must broaden the area for water transportation, also, so that it can live, if necessary, upon the trade of the towns accessible by boat. The Ohio can be connected by canal with Lake Erie, the Mississippi with Lake Michigan, and so on; and we can connect the entire

Mississippi Valley, the Gulf Coast, and the Atlantic Coast with each other by a system of sheltered waterways along the gulf and Atlantic coasts, such as was so ably discussed at the Philadelphia conference, consisting of bays, sounds and rivers to be connected with each other by canals, such as the contemplated canal across Florida connecting the gulf with the Atlantic Coast, the canal connecting the Carolina sounds with Chesapeake Bay, the canal connecting Chesapeake Bay with the Delaware River, the canal connecting the Delaware River with the Raritan, and the canal across Cape Cod, thus giving a sheltered waterway from the mouth of the Mississippi to Maine, upon which it is possible that boats of standard draft could pass from Boston down the Atlantic Coast, across Florida to the Gulf Coast, and up the Mississippi River to the Great Lakes. If these things were done, and warfare between the railways and the waterways should continue, there would still be sufficient transportation, without the distributing aid of the railways, to constitute a very influential part of the commerce of the country.

But it will scarcely do to predicate the improvement of our waterways upon the continuance of this antagonism. A few weeks ago I was quoted in certain Ohio newspapers as saying that the appointment of the Inland Waterways Commission was a part of the "Big Stick" policy of the President. Besides the fact that I never made such a statement, I believe the contrary to be the fact, and that the President, like the commission, is working for greater harmony, not to stir up antagonism, between the different transportation systems of the country. My own view is that the waterway system ought to be largely supplemental to the railway system and that it may possibly become necessary, in the event of continued hostility on the part of the railways toward the waterways, to enforce a liberal system of interchange of traffic and use of facilities between the two.

Viewing transportation in the large, it is of the highest importance that its machinery should be so adjusted that the common carrier can make the best and cheapest possible use, in the interest of the public, of all the public highways—of river, of railway, and of ocean. A perfect system of transportation would involve but one control from shipper to consignee, and our aim should be a system that will create great corporate carriers, under proper

regulation and control, owning railway lines from the Atlantic to the Pacific and from the lakes to the gulf, owning steamboat lines on the rivers and lakes wherever practicable and economical, and also owning great lines of ocean steamers, so that rates can be made and goods be carried from any point in this country to any other point in this country, or to a foreign country, under a single control and at a single rate, and that rate the lowest one consistent with good service and reasonable profit.

Legislative Requirements

Having said this much upon the physical requirements of the problem, let us consider what legislation is necessary in order to carry the undertaking into effect. And here the greatest difference of opinion is likely to exist; for while the country is practically united as to the necessity of undertaking the work, the machinery for setting it in motion has not been carefully considered and already there is divided counsel. It has been thought in the past that our government was incapable of engaging successfully in any great constructive work. This belief has been entirely disproved by the great works begun and continued under the direction of the Reclamation Service and the Panama Canal Service. In the legislation inaugurated for these public works Congress very wisely gave a free hand to the Executive, with the result that by a process of evolution a great administrative organization has been built up in each service, that has been conducted on thoroughly business-like principles. In a bill which I have recently introduced in the Senate (Senate Bill 500), I have endeavored to follow that beneficent legislation, by putting the whole responsibility for the development of the waterways of the country upon the Executive, whoever he may be, conscious that we will never have a dishonest Executive and that his highest pride will be to carry out successfully and economically the great charge entrusted to him. To put the Executive in a legislative strait-jacket would be sure to result in inefficiency and failure.

Inland Waterway Fund

The most important feature of this bill is the creation of an inland waterway fund, to be used both for investigation and construction. The sum of fifty million dollars is by the bill reserved

and set aside as such fund, and the President is authorized, whenever the fund is reduced below twenty million dollars, to make up the deficiency by issuing and selling bonds up to the amount of fifty million dollars. Thus the fund is always kept full, even though Congress should fail to make appropriations. The President is authorized to have examinations and surveys made for the development of the inland waterways of the country and for the connection of such rivers with each other, or with the Great Lakes, by connecting and by coastal canals. In order to enable the President to make such examination and to enter upon works found to be practicable, he is authorized to appoint an inland waterways commission, and to bring in co-ordination therewith the scientific services of the country, such as the Corps of Engineers of the Army, the Bureau of Soils, the Forest Service, the Reclamation service, and the Bureau of Corporations; and to appoint such experts and boards in connection therewith as he shall deem advisable; and to fix their salaries until the same are fixed by Congress. The commission is required to make reports to the President and to Congress, or to either body of Congress, whenever information is required.

Construction

The next question is as to construction. Under this bill, the President is authorized, whenever a project is determined by the commission to be feasible, to enter upon the immediate construction of the works and to let contracts for the execution of the same, in whole or in part; the only limit upon his power being that the necessary money for the payment of the contracts must be in the waterway fund when any such contracts are let.

It will be observed that the initiative, both as to examination and as to actual construction, is put in the hands of the Executive Department as an administrative matter. It is clear that the judgment of a board of experts will be very much better than that of Congress upon such matters, and that much delay and confusion will be saved by authorizing the prompt initiation of the work. Otherwise, we shall have difference of view, both in committees and in Congress itself, as to the details of the work, as to the relative importance of the projects, and sectional differences will arise, only to be compromised by concessions harmful to this great movement. Congress should exercise the fullest power of exam-

ination and of criticism, and, of course, it has the power at any time to change the organization or to stop the work. All these powers should be exercised whenever wise and necessary; but the main purpose of the bill is to enter upon the work in a business-like way, just as a private corporation would do, and not to impair its proper administration by unnecessary legislative restraints, or by the breaks and interruptions in the continuity of the work which have proven so disastrous heretofore when Congress has failed to continue to make the necessary appropriations.

The bill also provides for co-operation with states, municipalities, communities, corporations, and individuals with reference to such collateral works as have been suggested, and for an equitable distribution of the costs and benefits. Wherever practicable, compensation to the fund is to be secured by the conveyance of reclamation rights, the lease of water power, and such other means as may be beneficial to the states, municipalities, communities, corporations, or individuals affected. Equitable apportionment of the work among the several waterway systems of the country is also enjoined by the bill. It is intended that work shall be commenced contemporaneously among the different systems of the country, so that no section may feel that another section is being favored at its expense. The bill is tentative in its nature and designed to provoke discussion and to aid in the framing of a more perfect measure.

After Construction, What?

After these waterways are developed they must, of course, be freely used by the people; but their use will necessarily involve the creation of common carriers under laws either national or state. The business of common carriers is not, in these days, engaged in by individuals; the creation of artificial beings called corporations is necessary for this purpose. It is clear that the transportation of these waterway carriers will be interstate and foreign, and therefore subject to national regulation and control. The nation should itself create these corporations, and it should supervise their capitalization, control their profits, and make them the obedient servants of the people. At the same time it should protect them against the destructive competition of the railways. The nation ought not to allow one public servant (the railway company)

to destroy another public servant (the waterway company), both engaged in conducting traffic on the public highways of the country. It might, in order to encourage the operations of the waterway companies, exempt them for a period, as national instrumentalities, from taxation either national or state. These questions should be taken hold of at the start with a strong hand and the organization of the water carriers should not be left to the laws of the different states. We should not drift into confusion on this subject as we have regarding our railways.

National Incorporation of Carriers

The demand for national action as to water transportation will lead to national action regarding rail transportation and finally necessitate the creation by the nation of the corporations which are to handle both classes of traffic. We must begin to realize that three-fourths of the transportation of the country is now interstate; that our railroad systems are being operated regardless of state lines; that regulation by the individual states operating here and there on the sections of these great systems lying within their boundaries is disjointed, illusive, and illogical; that complexity, confusion, and insecurity, both to investors and shippers, are the results of the present system.

The truth is, we have not yet begun to think or act scientifically on this subject, but have allowed ourselves to drift, and the present railway system in this country may be called an accidental growth. The first railroads were built from a point in one state to another point in the same state, and their commerce was at first purely state commerce; but the railroad corporations, at first organized for the transportation of state commerce, gradually developed into great interstate systems, composed of many railroads combined under the laws of a single state, and that, oftentimes, a state entirely foreign to the region in which the system operates. In this way, six thousand railroad companies gradually came into existence, of which less than two thousand are now operating roads, the others having been merged into them; and of these two thousand, almost the entire mileage—at least 170,000 out of a total of 220,000 miles—is merged in eight or ten great systems, each controlling from ten to fifteen thousand miles of track and operating in from ten to fifteen different states. So that the growth

which began as a purely state growth became, by a process of evolution, a national growth; and it is no longer a question whether the railroads shall be nationalized—for they long ago nationalized themselves,—but merely a question whether we shall continue to permit the lesser sovereignties to assume the function which the nation has neglected of creating its own agents for the transportation of interstate and foreign commerce.

The National Powers

We cannot take the broad view of the powers of the national government as relating to waterways and carriers by water and refuse to recognize those powers as relating to railways and carriers by rail. It is curious how united public sentiment is as to the national control of the waterways and how divided it seems to be as to a similar control of the railways.

We have now forty-six sovereign states, each absolutely sovereign in all matters of local legislation, and each absolutely subject to another sovereign, the Union of the States, as to all matters entrusted by the Constitution to that Union. The main purposes of creating this sovereignty called the United States, were two: The national defense, and the regulation of interstate and foreign commerce. The regulation of interstate and foreign commerce involves necessarily the selection of the instrumentalities of that commerce, and necessarily, also, the selection of the public servants that are to engage in such transportation. The nation should itself create the great corporations which are to engage in interstate transportation by both water and rail. The reason the nation should frame the incorporation act under which great mergers are to be made is that we must prevent over-capitalization and we must limit their profits. If the nation is to permit a state to create the public agents which are to do the nation's business, it should control the legislation of that state; and that, of course, is neither desirable nor possible.

The purpose of the constitution was not to centralize government, but to unionize government, where the general welfare was affected. We unionized the quarantine, because we realized that disease had no respect for state lines; we unionized irrigation, because nature failed to place the rivers entirely within state boundaries; we unionized banking, because the interest of the entire people

required one money, a common denominator acceptable everywhere, and a system of exchange inviting universal confidence. And all the reasons which led to the unionizing of these functions of government in the past exist in far greater and stronger degree, at this time, with reference to the unionizing of the subject of transportation. We have just reached the threshold of this great question, and it is very important that we shall start right by the nation's creating its own public agents, and not permitting an inferior sovereignty to do so.

Mergers Necessary

We should drop excitement, reprisal, and retaliation, and get down to the question whether these mergers shall be broken up and resolved into their original elements of purely state railroads, or whether consolidation, properly controlled, shall be permitted. I think all thoughtful men will agree that the mergers of the railways are necessary to the proper development of the transportation system of the country, and that the fullest powers of combination should be exercised, under proper restraint as to capitalization, rates, and profits. To break up these mergers and resolve them into their integral parts, bounded and circumscribed in their operations by state lines, would be a national calamity, if it could be done, as grievous to the public as to the railroads. Leaving out of consideration, for the present, the combination of competing lines, these mergers have been of immense service to the country, although the machinery for bringing them about has been most complicated. The thing complained of is not the fact of combination, but the methods of combination, unrestrained by adequate laws and fruitful of over-capitalization, frauds on stockholders and frauds on shippers.

It is a universal experience that whenever the laws of a country do not meet its economic requirements the people will violate the laws or evade them. That is what has occurred in the case of the railroads. The ingenuity of all the corporation lawyers of the country has been exercised in order to promote the combination of single roads into systems. Although these combinations were absolutely essential to the best development of the country, the railroads were obliged, in order to accomplish them, to evade the laws. This is as much responsible for the spirit of lawlessness

in the management of the transportation interests of the country as any other one thing; and I am sure that, if this condition exists (and I fear we must all admit that it does), we, the lawmakers cannot escape our share of responsibility.

The railway is merely the agent of the government—the agent of the state as to purely state commerce and the agent of the nation as to interstate and foreign commerce; and the government has the power to fix the compensation, in the shape of rates on freight or the rate of dividend which the agent shall receive on his investment. It can fix this compensation in the form of tolls, or it can fix it in gross, and all that it must avoid is legislation of a confiscatory nature. I think, therefore, the reasoning is conclusive that, inasmuch as the state can legislate only for state commerce, it cannot legislate and ought not to attempt to legislate upon this great question of merger, which is only entered upon for the purpose of promoting interstate and foreign commerce; but that this can only be wisely accomplished by the action of the Congress of the United States, in which every state in the Union is represented, and in which every citizen has a voice and vote.

I am more and more impressed with the importance of the whole problem and with the necessity of preparing a broad and comprehensive plan for the improvement of our waterways and also for their co-ordination with the railway system of the country. Such a system of waterways, involving ultimately the highest development of forestry, of irrigation, of swamp land reclamation, of clarification of streams, and of bank protection as efficient means of maintaining a channel for navigation, would relieve vastly the existing congestion of transportation. The perfection of the transportation system of the country will, in my judgment, involve the creation by the nation of common carriers which will own not only great trunk lines of railway, but also lines of steamers on the lakes, the rivers, and the ocean. Combination is an essential part of the economic development of transportation. A perfect system involves, as far as possible, one control from shipper to consignee; and this can only be accomplished by great transportation lines operating regardless of state or national boundaries, which will utilize the railways, the rivers, and the ocean, by methods of carriage adapted to each.

A Comprehensive Measure

It is with such considerations in view, and for the purpose of effectually co-ordinating the transportation interests of the country, both waterway and railway, that I have introduced in the present Congress another measure known as Senate Bill No. 499. In framing this act, I have not urged the national incorporation of all railways, many of which lie entirely within the boundaries of a single state, but confine it simply to the construction of interstate railroads and to the combination of interstate railroads, already constructed, into great systems. As to existing roads, this can only be done with the acquiescence of the states. Some states might attempt to withhold their consent, but they would, in my opinion, soon yield when they found themselves outstripped by their more obliging neighbors. There are other ways of proceeding, but I should prefer persuasion to anything savoring of force; and when I speak of force, I do not, of course, mean actual coercion or the violation of the sovereignty of any state, but the prevention, for instance, of any corporation not under national charter from engaging in interstate transportation—a course unquestionably within the power of the nation.

The bill provides for the incorporation, under national law, of carriers, whether by rail or by water, engaged in interstate and foreign transportation, with a provision for the acquisition, with the consent of the states affected, of state-incorporated roads now in existence. The Interstate Commerce Commission is given full control over the capitalization, rates, dividends, and other incidents of the operation of such corporations. When promoters desire to construct a new line of interstate railroad, or to combine old lines into one system, they will be brought before this body of the highest intelligence, character, and efficiency, and present their plan; the amount of bonds they are to issue and the rate of interest, the amount of preferred stock and the rate of interest, the amount of common stock and the rate of interest, and the expenses of promotion; and, upon the approval of the commission, the consent of the nation will be given only after the most careful scrutiny and consideration and the genuineness of the whole transaction viséd by the government itself.

The bill also lays down a uniform method of taxation by the

states, and one per cent of the gross receipts is set aside annually as a special fund in the treasury of the United States for an insurance fund to the employees of the railroads against accident and liability. Dividends in any one year are limited to 7 per cent, except with the consent of the Interstate Commerce Commission, and any surplus goes to the betterment of the roads, or to a guaranty fund against future inadequacy of earnings for dividends, or to extra dividends if the commission consents. In fixing rates and dividends, the Interstate Commerce Commission are directed to have regard, as far as possible, to the maintenance of the par value of the stock. There is a provision for the Interstate Commerce Commission to act as a board of conciliation in the settlement of disputes between the railroads and their employees, on questions of hours, and of conditions and compensation of labor. It is stipulated that there shall be no interference with the local police regulations of the states, or with their regulation of purely state traffic, or with the jurisdiction of the state courts.

We welcome, therefore, the national consideration of all these questions relating to the inland waterways, because it opens up the greater question of transportation, regardless of state lines, by both rail and water, and because its very consideration will bring about a fuller exercise of the granted powers of the constitution. It seems to me peculiarly fortunate that this question of the improvement of the inland waterways has come up and arrested public attention as it has done, because, once public opinion is created, legislation will speedily follow. The whole question of transportation in all its branches will be opened up and intelligently discussed, and we may be able to incorporate in our legislation regarding the waterways some much needed legislation relating to the national incorporation of carriers whether by water or rail or both, and thus weaken the opposition of those who would prevent the co-ordination of the whole matter comprehensively, by indicating to them that the national powers regarding interstate and foreign transportation will not be exercised piecemeal or with reference to the one class of transportation and not with reference to the other.

If a proper system were created, most of the evils now complained of would disappear. A system of transportation could be easily devised which would enlist the best powers of the national

government without infringing at all upon the powers of the states —one which would protect alike the railway investor, the railway employee, the shipper and the public in their respective rights, and at the same time protect the states in all their legitimate powers, and change the hostility of the railways toward the waterways into friendliness and co-operation, in the interest of the entire people.

THE DELAWARE RIVER

By Hon. J. Hampton Moore,
Member of Congress, Third District, Pennsylvania, and President Atlantic Deeper Waterways Association.

The Delaware River is a great waterway which, one hundred years ago, furnished ample means of communication between the chief commercial city in America and the sea. Upon the banks of the Delaware were erected the great shipyards of the country. In colonial days, during the Revolutionary War, after the nation had been founded, and since that time, to and including the present day, the Delaware has been the American Clyde, and although commerce has been largely diverted to other ports than Philadelphia, the Delaware has remained the shipbuilding center of the Atlantic seaboard. But it has not continued to furnish ample means of communication between Philadelphia and the sea. That has been one of the reasons (but only one) why commerce has been diverted to other ports. When the ships of commerce drew no more than eighteen or twenty feet of water, they could reach the docks of Philadelphia through the natural waterway almost as readily as they could reach the docks of New York, but when the draft of merchant ships was increased to twenty-five, or thirty-five feet, shoals in the Delaware prevented access to the port at low tide and resultant delays compelled the larger and more economical ships to trade at ports where fewer obstructions were encountered.

Attempts have been made to remove the obstructions, thus restoring the conditions of equal competition under which Philadelphia was for a time the leading commercial city of the country, but in their results they have not kept pace with the growth in the size of merchant ships. The 30-foot channel in the Delaware is to be completed in June, 1908, but there is already urgent need for a 35-foot channel and before that can be completed a 40-foot channel will probably be required owing to the increase in the draft of vessels. The national government has done a great deal towards the improvement of the Delaware

River. Pennsylvania and Philadelphia have liberally supplemented the work of the Federal authorities, and yet much remains to be accomplished.

The importance of the work is not to be measured by the commercial interests of Philadelphia. The deeper channel is needed not only for the purposes of commerce, but to enable the great shipyards on the Delaware to send their products to the sea and to make available to the modern American battleship the greatest fresh-water naval station, dry dock, and repair shop on the Atlantic coast. The nation's interest in the improvement of the Delaware is superior to that of the City of Philadelphia, and will become a controlling interest if the deep waterway project should result in the construction of an interior line for the movement of battleships along the coast—a project of which the Delaware River will be the most important link.

Starting with the Delaware River as an adequate means of communication between Philadelphia and the sea, as it was a century ago, and indeed down to about 1850, let us see what has been done to improve it in order to keep measurable pace with the demands of commerce. The head of navigation is at Trenton, where natural falls limit the tidal flow. The river there is very shallow and no considerable depth is found north of Philadelphia. In front of the city there were flat islands which diverted the channel. From the city southward to deep water in the bay, bars, flats and rocky ledges obstructed the channel to some extent for considerable stretches, but even at these points the depth at mean low water was from seventeen to twenty feet, so that no great need for dredging operations appeared until after the Civil War. Here, as elsewhere, prior to 1867, few attempts were made to improve natural waterways except to meet local demands, and as a consequence the first efforts to improve the Delaware River were made on the river above Philadelphia. As early as 1836 the United States Government expended $15,000 in making a channel through Perriwig bar, where the depth of water was originally only three to six feet. The next appropriations (1872 and 1873) were also for improvements in the upper Delaware where depths of only eight to nine feet have been obtained. Attention was then turned to the lower Delaware, and a little work was done each year, but a quarter of a century elapsed before appropriations were made large enough to do much more than maintain the natural channel.

In 1885 a board was convened to prepare plans for a channel from Philadelphia to the sea 600 feet wide and 26 feet deep; and in 1899 another board was appointed "to revise the plans for improving the Delaware from Trenton to its mouth." Several other boards have been convened to pass upon particular problems, and the work has been in charge of a dozen different engineers in the course of thirty-seven years. It is quite natural that under such administration, mistakes should have been made, plans changed, costly work sacrificed and less good accomplished than was expected. This was not necessarily the fault of the engineers, who until recent years were always hampered by insufficient appropriations. The Delaware has, nevertheless, been greatly improved. At only two places is there now a less depth than thirty feet at mean low water, and the thirty-foot channel from Philadelphia to the sea will be completed in June, 1908. From 1885 to 1899 all appropriations were applied to the 26-foot project, and since March 3, 1899, all appropriations have been applied to the thirty-foot project.

From 1836 to 1899 less than $2,000,000 had been expended on the improvement of the Delaware, and the results accomplished were the forming of a channel not less than 7½ feet deep between Bordentown and Philadelphia, and of a channel not less than 20 feet deep between Philadelphia and the sea. In March, 1888, a resolution was approved providing for the appointment of a board of engineers to report upon the river between Philadelphia and Camden, and the report of this board led to a very great improvement of the harbor. The report recommended the forming of a deep channel 2,000 feet wide along the city's front at such a distance from the then wharf line as would permit an extension of wharves, and the widening of Delaware avenue. The plan involved the entire removal of Windmill and Smith's Island and their adjacent shoals and the cutting off of a part of Petty's Island. To accomplish this purpose the islands were bought at a cost, including legal expenses, of $708,000, the state paying $200,000, the City of Philadelphia $208,000 and the national government $300,000. A necessary part of the work was the extension of the wharves of Philadelphia and Camden so as to narrow the channel and produce the scour required for its maintenance. The city and the Girard estate greatly aided in this work, which was completely successful and brought about a marked improvement of the river front.

The river and harbor act of March 3, 1899, provided for the formation of a channel 600 feet wide and 30 feet deep to extend from Christian Street wharf, Philadelphia, to deep water in the bay, at an estimated cost of $5,810,000. This marked the beginning of liberal appropriations for the improvement of the Delaware, and the contemplated work is now approaching completion. Besides its appropriations for harbor improvements, the City of Philadelphia has expended $685,000 on improvements of the Delaware River, and in 1905 the State of Pennsylvania and city appropriated sums aggregating $750,000 for dredging operations between Philadelphia and the state line.

The work of dredging undertaken by the city and the state would have been done in time by the Federal Government, but the purpose of city and state appropriations was to expedite the improvements. There was a strong desire to begin work this year on a 35-foot project, and to that end it was proposed that surveys be made at once and plans prepared for the new work. But, following precedent, the river and harbor committee refused to begin a new project until the 30-foot channel should be completed.

The present condition is that a channel 8 to 9 feet in depth has been established between Bordentown and Philadelphia, a channel not less than 26 feet deep along the city front, and a channel 30 feet deep from the lower part of Philadelphia to the sea. Under the 26-foot project the government expended nearly $600,000 for dikes, and under the 30-foot project nearly $1,000,000 for bulkheads. In 1829 work was begun upon the breakwater, and continued until 1898, at which time its cost had reached $615,036. In 1897 the National Harbor of Refuge was begun, and up to 1901 near two and a half million dollars had been expended on this project. In addition to all this, the government has provided an excellent system of lighting the river.

The expenditures by the United States Government on account of improvements to the Delaware River, including the Delaware Breakwater and the Harbor of Refuge, have amounted to nearly $12,000,000. Philadelphia and Pennsylvania have added $1,500,000 to the expenditures for deeper waterways alone. More than one-half of the whole amount has been spent on the 30-foot project, from which it appears that the bulk of the work has been done in the last five years.

The Schuylkill River, the chief tributary of the Delaware, runs through the city and empties into the Delaware at the lower end of the city. It is navigable for only a few miles, but is a stream of great importance to the commerce of the city. League Island, which was presented by the city to the government to be used as a naval station and navy yard, is a large island at the mouth of the Schuylkill. Here the government has spent millions of dollars in reclaiming land, in the construction of work shops, in the building of a great dry dock, recently completed, and in dredging operations. It has treated the Schuylkill, however, as a local stream, except for its own purposes, and the improvement of that river, which is capable of being made an important factor in the commerce of the port, will probably have to be done at the expense of the city and state. The government, however, may aid to keep the mouth of the Schuylkill open for vessels of large draft, for the naval station at League Island is capable of being made one of the finest in the world. It is secure from attack, surrounded by fresh water, and within the limits of a great city which can at any time supply an army of skilled workmen and supplies of all kinds, for making repairs or building ships.

The one defect, the want of a channel to the sea sufficiently deep to float the larger vessels of the navy, will be removed by the completion next year of the 30-foot channel, for the rise of tide in the Delaware is six feet, and by taking advantage of the tides vessels drawing more than thirty feet can reach the city. In time of peace, naval vessels can afford to wait for the tide, but there are few that cannot now reach League Island at any stage of water. It is, of course, desirable that the channel should be further deepened, first to thirty-five feet and then to forty, because merchant ships cannot afford to be delayed; but for uses of the navy, the Delaware now meets ordinary requirements.

As a link in the chain of deep water ways from Boston to Beaufort, the Delaware is of first importance. Its 30-foot channel from Philadelphia to deep water in Delaware Bay will be ample until other links in the chain have been completed and by that time it will have been further deepened. The proposed Delaware and Chesapeake ship canal will at once put Philadelphia in communication with numerous important points on Chesapeake Bay and its tributaries. The extension northward to Raritan Bay involves

not only the building of a ship canal, but extensive improvements in the river itself, for the channel north of Philadelphia is only nine feet deep the greater part of the way to Bordentown. Southward from Philadelphia to whatever point may be selected as the outlet to the Delaware and Chesapeake Canal, the Delaware River is already an ample water way for the purposes of the proposed continuous inland route. The immediate demand is for the completion of the 30-foot channel from Philadelphia to the sea; then for a survey for thirty-five feet which is necessary to accommodate vessels of increased draft. The 30-foot channel is now assured, and it is believed that an awakened public sentiment will soon induce Congress to grant the survey for the additional five feet. All signs point to an improvement in the conditions surrounding the Delaware River. New Jersey, Pennsylvania and Delaware are aroused to the importance of developing the stream for enlarged navigation, and the naval authorities are interested because of the great public value and strategic importance of the fresh water repair station at League Island.

ENGINEERING FEATURES OF CHESAPEAKE AND DELAWARE, AND NORFOLK-BEAUFORT WATERWAYS[1]

By Major C. A. F. Flagler,
Corps of Engineers, U. S. Army.

The waterway from Boston to Beaufort Inlet has many links partially constructed: the Cape Cod Canal, the Delaware and Raritan Canal, the Chesapeake and Delaware Canal, the Dismal Swamp and Albemarle and Chesapeake canals paralleling each other, and the Core Creek cut now being made by the government from Beaufort Harbor to Pamlico Sound. All of these, however, are for a generally shallow draft commerce, ten feet at low water being about the prevailing depth. They are what may be termed barge canals. The great Atlantic waterways that we are discussing include this inland chain of artificial channels and also great natural channels such as Long Island Sound, the Delaware and Chesapeake bays. All of these large natural waters are being made navigable by the general government for ships of the largest draft and the connecting artificial channels should offer in the near future equal advantages. There should be no weak links in the chain.

The Two Waterways

The Norfolk-Beaufort waterway has its southern terminus at Beaufort Inlet, N. C., passes by a land cut, utilizing Core Creek, into the waters of Pamlico Sound, thence through Croatan Sound it passes into and crosses Albemarle Sound, and thence, utilizing small sounds and rivers, it passes into Norfolk Harbor through the Elizabeth River. Funds were partially appropriated in the last river and harbor act of Congress, and work is now in progress on the southern end of the waterway. This waterway is intended only for light draft traffic, mainly towed barges. Its main advantages are, that it opens up to water transportation the productive section of eastern North Carolina, and offers a safe inland passage for the smaller coastwise boats by dangerous Cape Hatteras. The two private canals referred to, the Dismal Swamp Canal and the Albe-

[1]A paper read before the Atlantic Deeper Waterways Conference, Philadelphia, November 19, 1907.

marle and Cheasapeake Canal, now furnish light draft channels from Norfolk Harbor into Albemarle Sound.

The Chesapeake and Delaware Canal route reported upon to Congress is that of the present Chesapeake and Delaware Canal, from Delaware City, Delaware, to Chesapeake City, Maryland. This route has been carefully surveyed and investigated by borings, and estimates submitted for ship channels of thirty-five and thirty-foot depths. These deeper canals lengthen the present artificial waterway by several miles of channel which must be dredged on the shallow foreshore of the Delaware River, and in the waters of Back Creek, Elk River, and Chesapeake Bay.

The Terrene

The country in which these waterways lie is practically of the same formation from northern New Jersey to any point on the South Atlantic coast that may be selected for an ocean terminus. The terrene is the great Atlantic coast plain about 100 miles wide, measured inland from the shore and extending out under the ocean for fifty to one hundred miles to the edge of the Continental plateau. It consists of rock of the tertiary period covered from thirty to two hundred feet deep with glacial drift, and broken at intervals by the deep gorges that were once the beds of the great glaciers of the Delaware, the Susquehanna, the Hudson, and others. Along the ocean shores this soil is supplemented by the sand brought down by wave action from the rocks of older geologic formation abutting on the coast in New England, Nova Scotia, Newfoundland and Labrador. All of this drift and sand is easily moved and molded by the forces of nature. The shore line is universally of sand, and generally the ocean shore is merely a narrow cordon of sand separating the ocean from the chain of inland waters. At places, this cordon is in two or even three distinct lines. I am indebted to a paper by Major Cassius E. Gillette[2] for the following theory of the formation of these cordons, given only in part:

> The sand driven shoreward (by the waves) up the gentle slope of the Atlantic Continental shelf gradually formed itself into an under water ridge parallel to the shore line. As it approached the surface, it was washed down by the ebb tide. This washing was irregular as to amount and location, and ultimately the tidal escape was through low places, gradually washed deeper while the waves, unopposed, built the intervening stretches into sand islands, and the low places became entrances into sounds or bays.

[2]Sea Coast Harbors in the U. S., International Engineering Congress, St. Louis, 1904.

A shore formed in this way naturally enclosed only shallow lagoons; but some of these, of large extent, eventually by wave and tidal action in their own areas, produced the deeps and shallows that we now find.

The Engineering Features

From Beaufort to Norfolk and from the Chesapeake to the Delaware, waterways must be located in this low-lying coastal plain, with its shallow streams and broad sheets of water. The question of construction of a waterway presents as its first and most difficult feature, the choice of route. There are so many offering nearly equal advantages, or equally balanced advantages and disadvantages, that it is difficult to reduce even the more obvious to a reasonable number for careful consideration. On the Norfolk-Beaufort route the waterway was divided for consideration into three divisions, and it was deemed absolutely necessary to examine carefully five routes in the first division, six in the second, and two in the third. From the Chesapeake to the Delaware, nine routes have been carefully considered. For both waterways many other routes have been proposed and considered, but not examined. On the Beaufort-Norfolk waterway the decision is rendered more difficult by the question of depth—some routes offering greater advantages for a ten or twelve-foot depth which disappear when a sixteen-foot depth is considered—these being the three depths that have been reported to Congress with definite estimates. It is probable that the best routes for these depths would yield in parts to other routes were a thirty-five foot ship canal contemplated. The great present demand for canals, to become greater in the future, will eventually require large ship canals along all the sections of the great route we are discussing as a whole. It is the part of foresight and economy that each route should be located with a view to the construction of a channel for the largest commercial ships. If channels of such dimensions are not needed at present or funds are not available for their construction, let the modest canal barge be constructed, of twelve to sixteen-foot depth; but with every provision made in the acquisition of land and the location of route to permit its future enlargement to meet any commercial demand that may arise. The projects for both of these waterways contain no provision for locks, and the expensive work of reconstructing locks of larger size will not militate against

enlargement of the waterways at any time by any increment, large or small.

The construction along both routes, of either a shallow barge canal or of a deep draft ship canal, is entirely feasible. The geologic formation is such as to offer variety of material: hard sands and gravels, marsh land, upland soils, decomposed peaty strata and the real quicksand. No rock is anticipated along these two routes. The project for both canals is for tide-level canals, eliminating the many problems arising with summit canals, in the arrangements needed for water supply and for avoidance of interference with local streams and drainage. Excavation by well-known engineering methods in both land and water cuts will constitute the bulk of the work. A troublesome quicksand on the Chesapeake and Delaware Canal, 7,000 feet long and forty feet thick, will offer interesting, but not difficult, study for its passage. Sliding side banks in one locality present difficulties to overcome. Permanent organization of plant and personnel must be considered and provided to meet the necessary work in the maintenance of channel depths and widths after completion, the removal of ice, the lighting and policing of the canal, and the repairs of banks, revetments and appurtenances. All of these have been carefully considered in the projects and estimates for these waterways, but their details, while of technical interest to the engineer, have no place in such a conference as ours.

In the further prosecution of the construction of the waterways along the route, and in discussion relative thereto, there are two obstructive and misleading engineering fallacies that will be certain to play a part on these canals as they have on those of the past.

Land and Water Cuts

A glance at the geography of our Atlantic coast shows an almost continuous line of bays, sounds, lakes, rivers and creeks paralleling the shore of the ocean from Florida to Cape Cod. It would appear at first sight that the excavation of a channel across the short intervals of land separating the links of the chain would create a magnificent waterway for commerce. This is not true; most of the stretches of water that we see on the map are so shallow that the excavation of channels is as much needed in them as through the land; and, furthermore, which is the point I wish to

bring out, channels dredged in bodies of shallow water are frequently more expensive than through land cuts, especially along this route. "All is not gold that glitters," and similarly, from a commercial and engineering standpoint, all is not water that is printed blue on the map. The land along most of the territory to be traversed by our route is low-lying marsh in which excavation is easy. It is frequently land of little or no value. (In my present district, which comprises part of five states, some thirty or more such cuts have been made, and all land required has been deeded to the United States free of cost.) Disposition of dredged material becomes simplified in land cuts, as it can be easily placed ashore where it will not return to the constructed channel, and the deposit of silt in such a channel will be only that washed from the channel itself, giving a minimum for annual maintenance of the channel.

On the other hand, a channel across a wide wind-swept area of shallow water with irregular tides and currents flowing across the line of channel, presents many difficulties not present in the land cuts. While the excavation in dredging may be less, the material dredged cannot usually be placed along the sides of the artificial channel, as a large portion of it would, in all likelihood, return to the channel. It must, therefore, be frequently towed long distances to a suitable dumping ground, and frequently pumped ashore from an artificial dumping basin by means of additional and costly plant. Still more important, the exposure of these channels to wave and current action makes their navigation difficult and their maintenance costly. In the higher latitudes these open channels are also rendered difficult and dangerous to navigation owing to the cross passage of large fields of moving ice during the winter season. The method of handling boats out of Baltimore through an open channel affected by ice fields will show the difficulties arising. I quote from a report of the war department:

> The experience of ice boats in Baltimore Harbor and the approaches thereto is very interesting and instructive. Within the harbor the ice formed in place constituted what is known as still ice. The traffic of the port and the passage of the ice boat through keep an open channel, the navigation of which presents no difficulty. The ice being "still" a channel or passage broken through it remains stationary in position. This is the state of the case until a point between North Point and the Seven Foot Knoll is reached. Here the ice is a drifting field. A channel way being broken through it drifts with the field. Therefore a passage broken through this

field and over the deep-dredged channel immediately moves off this channel, and in a short space of time, the work must again be gone over before any vessels can pass along the dredged way. * * * When ice is thus drifting, the method of procedure is the following: One or more vessels desiring to proceed to sea are towed by a tug boat and convoyed by the ice boat which precedes the tow. To allow for the drifting of the broken passage through the ice, the ice boat works not over the dredged cut but on the side from which the ice is drifting. The tow being at a proper distance behind can move along the dredged channel as the ice cut is passing over it.

These statements will, I think, show you that occasionally the land cut is more economical in construction, and still more frequently in maintenance. Generally the natural bodies of water offer the cheapest and best route, but the economy resulting from occasional resort to land cuts even paralleling such bodies of water should not be lost to sight, and not ridiculed when suggested.

Tide-Locks

The second fallacy is more dangerous and far-reaching than the first. It is the well-known tendency to consider tide-locks necessary on all tide-level canals to prevent dangerous flow in the canals due to the rise and fall of the tide. This tendency is not confined to the lay mind, but extends to many of our most celebrated hydraulic engineers. President Shonts, of the Isthmian Canal Commission, when the discussion of a tide-level or high-level canal was under consideration, was widely quoted as saying that "one lock (tide) being a necessity, the addition of four others becomes less objectionable." Was one lock a necessity if a tide-level canal had been decided upon? Many of our best engineers think not. During the French régime on the canal, a study of the subject by the most thorough students of the hydraulics of the canal in France, led to reports that it was not necessary, founded on careful calculation and investigation; and these reports were concurred in by the French Academy in 1887. Mr. Clemens Herschel,[3] one of the most noted of our hydraulic engineers, in an article questioning the necessity for a lock on a tide-level canal at Panama, says: "The idea of the Suez Canal was denounced by leading engineers of the day as an impossible work if built without a tide-lock, and held up to the scorn and ridicule of men by these same engineers and by some of the greatest statesmen of that period, as a bubble

[3]Engineering News, March 22, 1906.

scheme, sure to bring ruin to who would support it. . . . . Now, fifty years later, it is paying $17,000,000 annually to its stockholders, and a proposition to put a lock into it would be regarded as the suggestion of a maniac." The construction of the lockless canal of Corinth was delayed over 2,000 years after it was first projected owing to this same fallacy. It is now navigated with ease. An expensive tide-lock was put in the Albemarle and Chesapeake Canal, in Virginia, because a difference of level of eleven feet sometimes existed between the water at the ends of the canal, eighteen miles long. The lock is seldom closed, and then only to prevent erosion of the banks, which could have been easily met by revetment.

I think I can explain in a few words the cause of the existence of this fallacy. Difference of water level at two ends of an open waterway always causes flow, which increases as a direct function of the height. If the difference is constant, the flow is constant, and may be easily computed. Where the differences at both ends are caused by tides, the resultant difference is a constantly varying one. The head of water is rapidly changing, while the velocity engendered by it is slowly coming into life, retarded by friction and inertia. Long before a velocity equals that caused by the extreme tidal head, it is beginning to fail from a reversal of the tidal conditions. It results that currents thus engendered by constantly varying tidal heads never reach or even approach nearly the velocities corresponding to constant heads, equal to the tidal differences. Intricate formulæ, generally empirical, have been devised for making computations of velocities in these cases, but they are, I regret to say, little studied by many who should understand their use, and excessive currents are frequently predicted which have been computed for static heads. To prevent delays to vessels passing through canals, the banks should be revetted sufficiently to permit a fair rate of speed of the vessels without injury to the banks. Any current that an ordinary vessel can stem will not injure banks that permit a rate of five knots to passing vessels. Great difference of tidal levels at the ends of short open canals does in some cases require tide-locks, but these great differences do not exist in the waterways under consideration.

Pardon my digressing here to say, for fear of being misquoted, that I have always regarded a high-level lock canal as the best

type at the Isthmus of Panama, but for reasons not pertinent to this paper, and certainly not to avoid tide-locks.

Locks are, of course, necessary where a constant difference of level exists of considerable height between the ends of a canal to permit safe navigation, and they are frequently used for economical reasons to pass a high summit level, even when the ends of the canal may be practically at the same level. The Delaware and Raritan Canal doubtless requires consideration on these points but it is my positive and carefully considered belief that no lock of any description will be required in any part of the chain of waterways from New Jersey to the Carolinas. There may be many present who disagree with me on these points, but I ask you all, in considering future references to this waterway in the press or elsewhere, to take with a grain of salt any statement made as to the absurdity of land cuts paralleling bodies of water, or the necessity for locks on a tide-level canal.

Conclusion

There remains only for me to say that there is nothing, from an engineering standpoint, to prevent the construction of a ship canal from Beaufort, N. C., to Norfolk, Va., and across the peninsula of Delaware and Maryland. The same is doubtless true of other portions of the great Atlantic waterway, and the engineering talent of the country awaits only the provision of the necessary funds, whether from the national government or from private or corporate sources, to place at the service of the country's commerce this most magnificent highway.

CAPE COOD CANAL[1]

By Wm. Barclay Parsons, C. E.,
New York.

In the consideration of an inside water route along the Atlantic seaboard of the United States, the link that will connect the waters of Long Island Sound and Massachusetts Bay is, in respect of size and character of vessels and the extent of tonnage that will use it, the most important, and historically the most interesting of all the sections that, when completed, will make possible a voyage from Maine to the Gulf of Mexico free from interference by stress of weather or attack by enemy in case of war.

A glance at the map of Massachusetts shows projecting from its southeastern corner a great arm, running first easterly thirty-five miles and then northerly about the same distance, terminating in a hook at Provincetown. To this arm the name of Cape Cod is applied. This curious geographical formation is everywhere flat, with few hills, especially to the east, and is composed chiefly of sand and gravel. Around this cape all sea-going traffic between Massachusetts Bay ports, such as Boston and Portland, and all ports lying to the south must pass.

The circumnavigation of the cape is far from easy. On the south side lie Martha's Vineyard and Nantucket Islands, inclosing Vineyard and Nantucket Sounds, with their high tidal currents and many shoals; while to the east are the great shoals extending southeasterly to the celebrated Nantucket shoals, marked by the light vessel of that name. These shoals, the low, sandy coast, difficult to see in thick weather, the frequent fogs, and the unbroken exposure to northeast storms, have made the passage of the cape a dreaded one to all mariners, and the record of wrecks year by year, with their shocking loss of ships, cargoes and life, is ample testimony that their fears do not lack foundation.

The only place on the cape where its breadth is material is the southerly projection towards Falmouth, which, with the extended chain of islands, forms the eastern shore of Buzzards Bay.

[1]This paper was read before the Atlantic Deeper Waterways Conference, Philadelphia, November 19, 1907.

At the head of the bay the distance overland to Barnstable Bay is less than eight miles. This distance is made up in chief part by the Monument River to the south and the Scusset River to the north. Separating them is a ridge whose height is only thirty feet above sea level. The deepening of the rivers and the cutting of a canal through this ridge, making thereby a direct water route, avoiding the journey around the cape, is so obvious a shortening of distance and reduction of marine risks as to cause wonder it was not long since done. The contemplation of such a channel is, in fact, almost coeval with the Pilgrim settlement at Plymouth in 1620. The records of that colony show that in 1622 a party succeeded in getting a boat around the cape, only to have it lost in Vineyard Sound. The year following they discovered that from Manomet, an Indian town within twenty miles of Plymouth, there flowed a river southerly to a bay which opened towards Narragansett, and within a short time afterwards the thrifty colonists established there a trading station, between which and the Dutch settlement at Fort Amsterdam there at once developed a brisk trade, the Dutch vessels ascending the river to Manomet, whence the goods were carried the short remaining distance overland to Massachusetts Bay. Before the seventeenth century was one-third gone there was thus established the beginning of the Boston-New York water-borne trade, which has since grown to such huge proportions. The old name of Manomet has unfortunately been corrupted into the meaningless form of Monument, and as such is now applied to the river which the Plymouth colonists found.

The idea of extending this river not over two miles to the north so as to make a continuous waterway and dispense with a land portage must have soon occurred to the traders. At least no later than 1676 one Samuel Sewall records in his diary, under date of October 26th: "Mr. Smith, of Sandwich, rode with me and showed me the place which some had thought to cut, for to make a passage from the south sea to the north."

Officially, however, things moved slowly then, as they do now, and it is not until 1697, or seventy years after the arrival of the Dutch vessel from New Amsterdam, that the authorities' attention seems to have been drawn to it. In that year the records of October 30th, of the House of Representatives, contain the following resolution:

WHEREAS, It is thought by many to be very necessary for the preservation of man and estates, and very profitable and useful to the public, if a passage be cut through the land at Sandwich from Barnstable Bay, so called, into Monament Bay, for vessels to pass to and from the western part of this country,

Ordered, That Mr. Hohn Otis, of Barnstable, Captain William Bassett and Mr. Thomas Smith, of Sandwich, be and are hereby appointed to view the place, and make report to this Court, at their next sessions, what they judge will be the General Conveniences and inconveniences that may accrue thereby, and what the charge of the same may be, and probability of effecting thereof.

So far as the records give evidence, these citizens have not yet reported. In fact, as to any action by the Colony of Massachusetts, the matter lay dormant until May, 1776, when the General Court passed this resolve:

In Council. WHEREAS, It is represented to this Court that a navigable canal may without much difficulty be cut through the isthmus which separates Buzzards Bay and Barnstable Bay, whereby the Hazardous Navigation round Cape Cod, both on account of the shoals and enemy, may be prevented, and a safe communication between this colony and the southern colonies be so far secured,

Resolved, That James Bowdoin and William Sever, Esqrs., with such as the Hon. House shall join, or the major part of them, be a committee to repair to the town of Sandwich, and view the premises, and report whether the cutting of a canal as aforesaid be practicable or not. And they are hereby authorized to employ any necessary surveyors and assistants for that purpose.

As a result of this resolution a committee was appointed, and apparently for the first time proceeded on scientific lines by appointing an engineer, Mr. Thomas Machin. Mr. Machin at once began a survey, but the year 1776 being an important one in the annals not only of the Colony of Massachusetts but of other colonies as well, Mr. Machin was withdrawn in June of the same year by an army officer giving more concern to making a country rather than a canal, one George Washington, who wrote to the chairman of the committee that, "The great demand we have for engineers in this department has obliged me to order Mr. Machin hither to assist in that branch of the business."

In 1791, Massachusetts having now become a state, the legislature appointed a committee to again inquire into the possibility of a canal across the cape. From that time until 1824 the question

was continually before the state legislature. In the latter year the government of the United States intervened, and by a joint resolution of both houses the President of the United States was authorized to cause the necessary surveys, plans and estimates to be made for a canal across the cape. As a result of this survey, detailed plans were finished for a canal which was to be thirty-six feet wide on the bottom, sixty feet wide at the surface of the water, with a depth of eight feet, the canal to be equipped with locks.

The eminent French engineer, Major William Tell Poussin, who visited this country in 1831, and who, on return to France, made an extensive report on public improvements of the United States, describes, with elaborate drawings, the Cape Cod Canal as being one of the greatest pieces of construction contemplated on the American continent. From 1830 to 1860 the project languished, but in the latter year the legislature of the State of Massachusetts once more took it up, reported, and again reported in 1864. From that date until the present the question of the canal has been at intervals under discussion. The state granted a charter under which work was actually begun; funds, however, were not forthcoming in sufficient amount, the work was abandoned, and the charter allowed to lapse. In 1899 the legislature passed another charter, amended in 1900, in accordance with which plans for a canal have been prepared by the writer, submitted to the joint board of railroad and harbor and land commissioners of the State of Massachusetts, approved by them and work begun.

All the early schemes for a canal at this point contemplated locks. Brevet Major-General J. G. Foster, Lieutenant-Colonel of Engineers, U. S. Army, in 1870, was the first to call attention to the fact that, although there is a considerable difference in tidal phenomena at the two ends of the canal, nevertheless the resulting current will not be sufficient to require locks. This same view has been sustained by many eminent authorities, among them the late Colonel A. L. Rives, for many years superintendent and chief engineer of the Panama Railroad; Dr. Elmer L. Corthell, the associate with Captain Eads in the Mississippi jetties, and himself the constructor of many notable harbor developments in various parts of the world, and Mr. Clemens Herschel. The plans that are under construction therefore contemplate a canal free from locks or dams. The law requires that the bottom width shall be not less

than 100 feet, with passing places where the bottom width shall be twice as great, and with a minimum depth at any point at mean low water of twenty-five feet. In actual construction it is probable that the minimum width will be greatly exceeded; in fact it is most likely that the passing places, instead of being made three in number, will be connected so that the canal will have everywhere a bottom width of 150 to 200 feet, and a width at the surface of from 250 to 500 feet, depending upon the slope that the banks will take. These dimensions can be compared with a bottom width in the Suez Canal of 147 feet, in the Kaiser Wilhelm Canal at Kiel of 72 feet, and in the Manchester Canal of 120 to 200 feet; the depths of these canals vary from twenty-six to thirty feet.

From the shores of Barnstable Bay to the shores of Buzzards Bay is a distance of eight miles. The sharpest curve is projected to have a radius of 7,640 feet, so that navigation for vessels of any size within the limits of depth will be simple. At the south end Buzzards Bay is land-locked and affords an excellent harbor; at the north end the canal will flow directly into the open waters of Barnstable Bay without any natural protection. This bay is open to storms from the north and northwest. It is proposed, to provide protection against winds coming from this direction, to build a breakwater for a distance of 3,000 feet, running easterly and extending to the six-fathom curve at low water, so that vessels entering from the open bay, even in rough weather, will be able to obtain smooth conditions before entering the canal. In addition, the United States Government should construct a harbor of refuge by the building of other breakwaters, so that vessels, after having passed the canal, may lie at anchor in the waters of Barnstable Bay until such times as they are ready to continue their voyages, if delayed by stress of weather, accident or other cause. Such harbor is so obviously a part of open sea navigation that it logically should be done by the government as similar works are done along the coast, and not by a private company.

This canal is not a channel for local traffic, but is essentially a ship canal for ocean-going vessels in through service. The figures of proposed depth and width of the Cape Cod Canal show that it will be of the same general character as to size as the great ship canals of the world, and the dimensions are amply sufficient to accommodate all vessels engaged in the coastwise traffic

at any stage of tide, and permit them to pass each other in opposite directions without hindrance. In fact, the canal will be of really greater capacity than the above figures would indicate, which are based on mean low water conditions. Since the tide rises in Buzzards Bay about five feet, the depth of water in the canal when there is high tide in Buzzards Bay will be thirty feet, a depth that will be substantially maintained at that time through the canal, as mean tide at Sandwich which occurs when there is high tide in Buzzards Bay will also give thirty feet depth at the north end. Available draft can therefore be said to vary from twenty-five feet as the minimum to thirty feet as the ordinary maximum. The latter depth would suffice to carry vessels of the battleship class, should the government ever have occasion to send such vessels through the canal.

The general trend of the Atlantic coast is northeasterly. A straight line drawn from the mouth of the Chesapeake, or the mouth of the Delaware, or from Sandy Hook, to Boston, will cut the land well to the westward of the proposed canal. The actual saving in distance will therefore be the same for any vessel trading between a Massachusetts Bay port and practically any of the ports on the Atlantic seaboard. Vessels now making this journey have two courses open. If going from New York they can pass through Long Island Sound and Vineyard Sound around the cape; or they can go by sea past Sandy Hook, and then from Montauk Point either through Vineyard Sound, as before, or to the southward of Martha's Vineyard and Nantucket Islands around the cape. Vessels from Philadelphia, Baltimore, Newport News, Norfolk, Wilmington, Charleston, Savannah, Brunswick, or any other port, can pass Montauk Point and go either through Vineyard Sound, as above, or to the southerly of the two islands.

Taking a common point of departure by the inside route through Vineyard Sound, there would be a saving in going through the canal of sixty-six miles in distance; or, by taking another common point of departure outside of Montauk Point, there would be a saving of sixty-three to seventy-one miles for vessels going through the canal instead of passing to the south of the islands, according as bad shoals are crossed or avoided. Or, if in the latter case, a vessel should wish to escape all the Nantucket shoals and make a complete circuit rather than go across, there would be

a saving of 129 miles between New York and Boston, and 105 between Philadelphia and Boston. For points south of Philadelphia, the saving in distance would be substantially the same, although, as compared with the journey length, necessarily proportionately less. The saving in distance is not, however, the only saving that would be realized, as the worst part of the journey is the journey around the cape, whether it lies across the shoals or goes around them.

Fogs, storms, and adverse currents frequently keep vessels storm-bound either at Provincetown or in Vineyard Sound for days at a time, so that no certain time of arrival can be predicated even for vessels in tow, still less for vessels under sail, while the terrible list of wrecks on the shores of the cape attest the foolhardiness of attempting to make the journey in bad weather. During the year 1905, the last for which statistics are available, fourteen vessels were lost on the shoals and the short stretch of thirty-five miles of Cape Cod coast. The tonnage of these wrecks composed 24.1 per cent, or say one-quarter, of the total tonnage of wrecks reported on the whole coast line of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut and Long Island. So measurable is the danger of Cape Cod transit, as compared with the quiet navigation of Buzzards Bay and the canal, that inquiries addressed to the marine underwriters in New York elicited the response that insurance rates on the cargoes of sailing vesels and barges would be reduced from 10 to 25 per cent to vessels using the canal.

The traffic that would seek the canal route is of three classes:

First. Passenger steamers between New York and Boston. This business is now handled in two ways: by vessels running to Fall River, Providence, New Bedford, or other sound ports, and thence by rail to Boston, or by vessels going around the cape. The first method requires but one night for the journey, but it involves a transshipment of passengers and freight inconvenient to the former and expensive for the latter. The second method requires usually eighteen to twenty hours, or say a night and the forenoon of the following day, unless further delayed by thick weather. The canal will permit the journey to be completed in thirteen to fourteen hours, or comfortably between evening and early morning. To show the extent of this traffic, there are running regularly every night between New England ports, exclusive of any north of Boston, twenty-four large steamers both ways, of which sixteen carry

passengers. During the summer not only is the total increased, but also the percentage carrying passengers. Of the twenty-four, the New England Steamship Company controls sixteen. All these steamers pass out through Long Island Sound, and by far the greater portion of the passengers and freight would be more expeditiously, economically and comfortably handled through the canal.

Second. Steamers carrying chiefly freight, but also some passengers, between Boston and ports south of New York. Lines are regularly established from Boston to Philadelphia, Baltimore, Norfolk, Charleston, Savannah and Jacksonville, with twenty sailings weekly both ways, offering an annual freight capacity of more than 2,000,000 tons. In additon there is a large volume of freight traffic, chiefly fruit, from the West Indies and Central America, steamers from such ports entering at Boston Custom House to the extent of over 200 annually. All this traffic could save by the canal, and much of it will use it.

Third. Freight traffic of raw materials transported in sailing vessels or barges. This traffic would furnish the major volume of the canal business, and it consists chiefly in coal, southern lumber for New England, Maine lumber, such as spruce for points south of the cape, stone from Massachusetts and Maine, ice south-bound, cement, brick and lime north-bound, oil and oil products, cotton reshipped at New York, and other bulky commodities. Such articles must be transported cheaply. The New England railways leading from New York are now so congested with passenger traffic and the carrying of high classified freights that such articles as those stated above cannot be given the low rates that their value demands—such traffic must go by sea.

In point of tonnage the biggest item in the above list is coal. During the year ended June 30, 1907, it is estimated that the coal shipments to Massachusetts Bay ports, of which Boston and Portland are the chief, amounted to no less than 12,000,000 tons which were shipped from New York, Philadelphia, Baltimore and Norfolk. Exclusive of the freight carried in the regular coastwise steamers, it is estimated that the other commodities aggregated during the year some 5,000,000 tons, making a gross total of about 18,000,000 tons.

From these statistics, and the diversified points of origin of traffic, it will be seen that this canal is of national importance. Although nominally the bulk of the cargoes that will use it north-

bound start from New York, that port is not the originating point. The cargoes represent the produce of the many states seeking their market through a convenient channel—coal from Pennsylvania and West Virginia, tobacco from Virginia and the Carolinas, timber from Georgia, cotton from the whole of the great South. It is an enterprise in which every state on the Atlantic seaboard, from Maine to Florida and Texas, is interested.

If the volume of traffic already in existence is so great, and the saving in distance, delay and danger of such importance, the question naturally arises why, after 300 years of agitation, the canal was not built before. The answer to this very natural question will be found in the change that has been taking place in water transportation, a change which has made it possible for the State of New York to throw away its enormous investment in the existing canal system of the state and build an entirely new system from Lakes Erie, Ontario and Champlain to Albany, at a cost of over $100,000,000.

As long as the coastwise traffic was controlled by schooners, with a recognized unknown length of journey and an amount of delay impossible to forecast, the value of the distance and time saved was not of so much importance as to overcome the expense to a sailing vessel in traversing the more or less narrow waters of Buzzards Bay and being towed through the canal. Steam, however, within the last few years has been making the same inroads into the methods of coastwise traffic that it has already made in ocean traffic, so that the schooner is following in the footsteps of the picturesque clipper ship, and is giving way to the tug and tramp steamer.

As soon as a vessel owner adopts as a motive power an agent that will enable him to send his vessels on a schedule he at once begins to take account of delays, and places a money value against the time lost. This method of reasoning—and it is sound—warrants the expenditure of large sums in the improvement of waterways, such as the Cape Cod Canal, that would not have been, and were not, justifiable one or two decades since.

To-day the greater part of the coal traffic between New England, New York, Philadelphia and Norfolk is handled in barges, usually two or three in number, behind an ocean-going tug. To show the extent to which the new methods of transportation

are superseding the old, the statistics compiled by the chamber of commerce for the port of Boston each year are at hand. In 1902 there arrived in Boston from domestic ports south of Cape Cod 1,033 steamers, 1,209 sailing vesels, 909 tugs and 1,879 barges; total, 5,030. In 1906, four years later, there were 1,148 steamers, 900 sailing vessels, 1,166 tugs, and 2,458 barges; total, 5,672. The aggregate vessel tonnage of the former year was a little over 5,000,000 tons, and of the latter nearly 7,000,000 tons.

The thing that strikes one in these statistics is the small increase in vessel number and yet the large increase in vessel tonnage, indicating an increase in average size of unit. While the total number of steamers remains substantially the same, sailing vessels have decreased 25 per cent in number and the barges have increased more than 33 per cent in number.

In 1902, of the total entrances at Boston, steamers comprised 20.5 per cent, tugs 18 per cent, sailing vessels 24 per cent and barges 37.5 per cent. The same division in 1906 was: steamers 20.3 per cent, tugs 20.6 per cent, sailing vessels 15.8 per cent, and barges 43.3 per cent. Or, taking the United States Government figures for 1905 and comparing them as a matter of convenience with the census returns for the year 1899, of the total tonnage carried to Boston 53.9 per cent went in steamers in 1899, and exactly the same in 1905; but while barges carried but 21.1 per cent in 1899, they carried 31.3 per cent in 1905, and the sailing vessel tonnage, which had accounted for 25 per cent of the whole in the first year, had fallen to 14.8 per cent in the second.

This same general change in traffic conditions will apply equally to all waterways that are to be hereafter constructed, and any waterway that is either to be constructed anew or to be made by the improvement of existing conditions, must be undertaken with the view of its exploitation by vessels whose power will be for the most part something other than sails. With the Cape Cod Canal established, the great source not only of danger but of delay will have been removed, and the towing companies, whether private or part of the various coal companies' equipment, can estimate with reasonable certainty upon the time of departure and arrival of their tugs, in fact with a much greater certainty than for similar shipments by rail.

Its national rather than local character is to be impressed on

the attention of this convention, as this canal will do more than make a water route from New York to Boston. It will at once, by means of the Raritan, Delaware and Chesapeake, and other canals, complete an inside route safe at all seasons for all boats from North Carolina to Maine, and that without a single dollar more to be invested by the nation or any state. From that point the labors of this convention can be exerted to deepen, widen and develop the existing links and construct the others that are now lacking, so that this inside route may be continuous and of sufficient size for modern requirements. To this end not only must canals be built and small rivers enlarged, but the attention of those in authority must be directed to the further increasing of the capacity of the limiting conditions of some of the main arteries. The port of New York is the country's largest gateway. The general government has been at work for years, and has at last almost completed a new deep channel to sea. That channel is, however, for foreign commerce. The harbor has another entrance from the sound through the East River; this is the channel for internal commerce. It is the channel on which three states—New York, Connecticut and New Jersey—look directly, and it is the one used chiefly by the domestic ocean commerce of the Atlantic States. Although much improved over conditions existing twenty years ago, it is still much restricted by islands, reefs and narrow channels. If any great inland route is to be established it becomes the throat where all traffic will be congested; it is the one place which all are interested in having developed; it is one of the improvements to be most urged by this convention upon the national authorities.

ATLANTIC COASTWISE CANALS: THEIR HISTORY AND PRESENT STATUS

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The Atlantic Coast offers exceptional opportunities for the realization of an efficient coastwise water route from Boston to the Carolinas. The construction of four canals, with an aggregate length of less than one hundred miles, will provide one thousand miles of protected inland navigation, while the extension of this system, by means of a canal across Florida, would connect the vast Atlantic coastwise trade with that of the Mississippi.

This system was partially realized more than three-quarters of a century ago. The Chesapeake Bay was connected with the bays of North Carolina by means of the Dismal Swamp Canal in 1828 and with Delaware Bay one year later, while the Delaware River was connected with Raritan Bay in 1838. No exceptional engineering difficulties were encountered and comparatively few locks had to be constructed to overcome the rise and fall due to elevations. The Delaware and Raritan Canal required the construction of fourteen locks, but all of these were at the entrances to the canal, so that for the entire distance of forty-four miles navigation was not impeded by a single lock. The passage between Delaware and Chesapeake bays was made by the use of three locks, two of which were at the entrances; while the Chesapeake and Albemarle Canal, which has monopolized most of the trade of the Dismal Swamp Canal since its completion in 1860 has reduced the number of locks between the Chesapeake and the bays of North Carolina from seven to one. In fact, most of the proposals for the construction of ship canals along these routes assert that locks can be dispensed with entirely.

Notwithstanding the increasing demands of the coastwise trade, the dimensions of these canals have not been materially increased since their completion save in the size of locks. The reason for this is clear. The canals had to meet the competition of the railroads from the very outset for the trade which, at the time of their

organization, they hoped to monopolize. In fact, the Delaware and Raritan Canal was forced to enter into a union with the Camden and Amboy Railroad in the first year of its existence in order to prevent immediate abandonment of its charter privileges. Up to 1870 the canals enjoyed an increasing trade, but the financial return was not sufficient to warrant any undertaking for extensive improvements.

THE PRESENT DIMENSIONS OF COASTWISE CANALS AND LOCKS.

	Length.	Width.	Depth.	Rise and Fall.	Locks.		
					No.	Length.	Width.
	Miles.	*Feet.*	*Feet.*	*Feet.*		*Feet.*	*Feet.*
Delaware and Raritan	44	80	7	150	14	220	24
Chesapeake and Delaware	14	66	9	32	3	220	24
Dismal Swamp	28	60	6	35	7	100	16½
Chesapeake and Albemarle	14	80	7½	2	1	220	40

Since 1870, owing to the rapid improvement of the roadbeds of the railroads and the traction power of the engines on the one hand, and the lack of improvements of canals on the other, the trade of the latter has declined rapidly. The traffic of the Chesapeake and Delaware Canal, which reached its maximum of 1,318,772 tons in 1872, has fallen to 639,548 tons in 1900, while the traffic of the Delaware and Raritan, which exceeded 2,000,000 tons in 1870, decreased approximately 1,000,000 tons in less than twenty years. Unlike most of the canals in other sections of the country, the coastwise canals, save the Delaware and Raritan, have remained independent, but they have abandoned all hope for revival through independent action and have turned to the Federal government for aid. It is the main purpose of this article to trace the relation of the Federal government to the coastwise canals.

The Chesapeake and Delaware Canal has special claims upon the Federal government for several reasons. The construction of a ship canal which would permit the passage of the largest vessels would be of great commercial and military value. It is the latter point which the promoters of the canal emphasized from the beginning in their appeal for national aid. It was first made in 1805,

when Gallatin recognized the force of the claim and recommended immediate subscription on the part of the National government. But the constitutional objections questioning the right of the Federal government to exercise such power were so strong that both the Senate and the House bills, introduced in 1810 for that purpose, failed to pass. After the War of 1812, a majority of the members of both Houses waived the constitutional objections and passed the Internal Improvement act of 1817, but it received the veto of Madison, who still clung to the constitutional objection. Monroe belonged to the same school as Madison, and it appeared that national aid was doomed for another eight years. However, he finally yielded, in 1824, and within the following five years the Chesapeake and Delaware Company received from the National government subscriptions to the extent of almost one-half million dollars. This sum, together with the subscription of $175,000 made by the states of Pennsylvania, Maryland and Delaware, enabled the company to complete the canal in 1829.

When the period of decline in the traffic set in, the managers started a movement to arouse the interest of the federal government in the plan of constructing a ship canal. This movement began in 1871, when the National Commercial Convention memorialized Congress on this subject. The government engineers were instructed to examine routes and make estimate of cost which were published in the annual report of the chief of engineers for 1872. In the same year, Maryland chartered the Maryland and Delaware Ship Canal. This company claims the right of way on the Sassafras route from Kennedy's Mills, at the headwaters of the Sassafras River, to the Delaware River near Liston's Point. Ever since, this company has been a rival of the interests of the old canal in presenting to the general government its superiority as a ship canal route.

The River and Harbor bill of 1878 directed the survey of all the routes which a ship canal was likely to follow. The engineer's estimates and recommendations were to be based upon the construction of a canal 178 feet wide at low water and 100 feet wide 26 feet below mean water. The locks were to be 600 feet long and 40 feet wide. Three routes were reported which were designated as the Northern, Intermediate and Southern. The Northern route followed the Sassafras River already mentioned, the Inter-

mediate route entered Chesapeake Bay at the Chester River and Delaware Bay at the Broadkill River, and the Southern route made use of the Choptank River, Ferry Creek, Manticoke River, and Broadkill River. The primary purpose of these proposals was to furnish Baltimore with a shorter route to the sea, and hence the utilization for that purpose of the Chesapeake and Delaware Canal which follows the most northerly route was not even considered. Provision was again made, in 1882, for similar surveys with the same end in view.

It was not until the survey of 1894, made under the direction of L. Case, as chief engineer, that the Chesapeake and Delaware Canal claims met with favor. This report lays emphasis upon the coastwise trade as against the claim of Baltimore for an outlet to the sea, and concludes that for this purpose the most northerly route is the most desirable. Twelve years later (1906) Congress authorized the appointment of a special commission which was instructed "to examine and appraise the value of the works and franchises of the Chesapeake and Delaware Canal . . . with reference to the desirability of purchasing the said canal by the United States and the construction over the route of the said canal of a free and open waterway having a depth and capacity sufficient to accommodate the largest vessels afloat at mean low water," and also to make an estimate of the cost of the same from the surveys heretofore made under the direction of the War Department. Of all the other routes formerly proposed, the feasibility of the Sassafras route alone was to be considered by the commission. Their conclusions with regard to the advantages of the two were to be based upon commercial and military considerations.

The commissioners reported that both routes were feasible, but decided in favor of the Chesapeake and Delaware Canal because they believed that this route possessed slight military advantages and could be constructed for two million dollars less than the Sassafras Canal. The estimates included a valuation of the properties and franchises of the Chesapeake and Delaware Canal at two and one-half million dollars, and the franchises of the Sassafras route at one million dollars.

Another important link in the inland coastwise system in which the National government has been previously interested is the

Dismal Swamp Canal. The promoters of this canal were organized in 1787, and here again the abandonment of the enterprise was prevented by the subscription of $200,000 by the National government, in the Twenties. Since that time the company has made several attempts to improve the canal. In 1856, $150,000 were raised for that purpose, but the work was interrupted by the Civil War. In 1867, the company made another attempt to raise $200,000 for the purpose of widening the canal from thirty to sixty feet, and increasing the depth from five and one-half feet to eight feet, which would make it possible to dispense with all locks save at the entrances. This sum, however, was exhausted while the improvement planned was yet in an unfinished state, and foreclosure was threatened. At this point, the company again appealed to the National government for aid upon the ground that the nation had an interest in this canal. The claim was made that the Dismal Swamp route was preferable to the Chesapeake and Albemarle route, which, since its opening in 1860, had monopolized most of the trade because it admitted boats of greater tonnage. An extended correspondence between the company and the national treasury department ensued between 1871 and 1878, setting forth the financial interest of the government in the canal. A survey was made in 1878, but beyond this nothing was accomplished.

Some twenty years later the River and Harbor Act (August 7, 1894) provided: "For the survey of the waterways through the sounds of North Carolina and for the survey of the Dismal Swamp Canal . . . with a view of obtaining a depth of nine feet and the necessary width of a ship canal . . ." The report of the survey, made in accordance with this act, showed that not more than two feet available water could be depended upon in periods of drought, and three and one-half feet in wet seasons, although the depth was much greater than this except at a few places. The construction of a canal with a depth of ten feet and a width of eight feet at the bottom was recommended, and the cost was estimated at $1,711,380. This included the construction of three locks, the dredging of eighteen miles of canal, and the clearing of Croatan Sound and Paskuotank River. The report further declared that a sufficient amount of water could be obtained from Lake Drummond for the operation of the canal.

This survey, as the former ones, did not materialize in anything, and there is a great question whether it should in view of the fact that the Chesapeake and Albemarle Canal already offers a large part of the trade an opportunity to follow a protected inland route. This canal is eighty feet wide at the top and sixty feet at the bottom, and has a depth of seven and one-half feet. Although the entire route of the latter, including bays and rivers, is considerably longer than the former, the canal itself is six miles shorter and passage is made by the use of only one lock. Ever since its completion in 1860 it has taken most of the trade which formerly followed the Dismal Swamp route. In 1871, the number of passages through the Chesapeake and Albemarle Canal were twice those of the Dismal Swamp Canal, and in 1895, the tonnage (324,866 tons) of the former was almost fifteen times that of the latter. Unless the Dismal Swamp route can show a decided superiority, the improvement of the Chesapeake and Albemarle route will be the policy of the future, especially since there is only a remote possibility of government aid upon which the revival of the Dismal Swamp project must depend.

A third important link in the perfection of the coastwise system is the Delaware and Raritan Canal. In 1870, the traffic of this canal exceeded that of any other east of the Allegheny Mountains. The two million tons then carried were composed chiefly of coal shipments from Philadelphia and the outlet locks of the Delaware Division Canal at Well's Falls. When the canal was leased by the Pennsylvania Railroad in 1870, all the Schuylkill coal traffic under the control of the Philadelphia and Reading Railroad, which in that year amounted to 746,661 tons, had to seek either the railroad or the ocean voyage for points to the north and to the east. As a result, the tonnage of the canal decreased by one million within the next twenty years, while at the present time it is practically abandoned.

This condition has been reached in spite of the fact that no other waterway has such a commanding position with reference to the coal mines of Pennsylvania and the coastwise trade. In 1892, the Committee of Commerce estimated the sound traffic at 3,313,110 tons, the Hudson River trade at 7,642,282 tons, the resources of the Jersey rivers tributary to Raritan Bay and the Delaware and branches at more than 12,500,000 tons, and the traffic

of Chesapeake Bay at 6,619,424 tons. In addition to this, the committee emphasized the fact that the military advantages of the proposed canal would be "the first link of an interior waterway safe from military attack and reaching from New York Bay to Florida and thence to the gulf." But, notwithstanding this passing interest of the federal government and the support of numerous associations in Pennsylvania, New Jersey and New York, the immediate future holds out little hope that the proposed ship canal will be undertaken by the national government or by private enterprise.

The improvement of the three canals which have just been described to the dimensions of ship canals would furnish a protected voyage for the coastwise trade from Cape Cod to the Carolinas. Numerous movements have been started to extend this system by the construction of canals through Florida and Cape Cod. The latter promontory is only ten miles wide at a number of places, and a cut through it is easy of construction; in fact, the claim is made that dredging alone will accomplish the result. And yet, for several centuries, this narrow neck of land has been permitted to increase the distance between Boston and points to the West and South between seventy and one hundred and twenty miles, and to force the commerce through shoals and fogs which, in point of danger, are only second to those of Cape Hatteras. The record of loss for twenty years ending in 1895 is 63 lives and 137 vessels, the value of the latter is estimated at one million and a half dollars. In the short period of four years following 1895, twenty-seven lives were lost and twenty-seven vessels valued at a quarter of a million dollars, were wrecked. This constitutes an average loss of $6,500 per month, and three vessels and three lives for every two months.

The amount of traffic which has been forced to follow this circuitous and dangerous route has always been great and promises to increase steadily in the future. The enlarged Erie Canal will connect the sound with the lakes of the West, and the completion of the proposed Cape Cod ship canal will enable Boston to compete for the trade of the West. The claim is made that the freight which railroads bring to Jersey City, and which is bound for Boston, will be transported at one-third the rate now charged by railroads. To this we must add the advantage to the extensive commerce with the ports to the south of New York City.

In view of these facts, the postponement of completion of this canal to the opening years of the Twentieth century constitutes one of the greatest surprises in the history of canal construction, especially since the proposed cut has received attention for more than two centuries. Agitation was started by the little town of Sandwich, in 1676. The project was encouraged by a survey under the direction of the General Court of Massachusetts, in 1697, and again, in 1776, when General Machin was engaged to make a survey. The Revolution intervened and the plan was postponed until 1824, when the federal government engineers were directed to make surveys. Another federal survey was ordered in 1860, but again postponed until 1875, when General Foster, of the United States Engineers, made a thorough examination and recommended the abandonment of the former lock navigation proposals in favor of a deep-cut ship canal. A number of favorable congressional reports followed some ten years later, but all the work of the national government in the nineteenth century, like the agitation of the colony of Massachusetts in the eighteenth century, came to naught.

Finally, a few enterprising individuals formed "The Boston, Cape Cod and New York Canal Company." A charter was obtained from the Commonwealth of Massachusetts, permitting a capitalization of $6,000,000. Under the direction of this company, surveys have already been made and a route selected which, it is believed, will be free from rocks. The managers are "confident that two years and a half will witness the completion and opening of the waterway."[1]

The full value of this coastwise system will not be realized until a canal is constructed across Florida. Agitation in favor of such a canal began as early as 1826, when the general government ordered surveys of two routes for the purpose of connecting the Atlantic coast trade with the Mississippi. One of the routes surveyed followed the St. Mary's and Apalachicola rivers a distance of some 200 miles, while the second route, about fifty miles shorter, proposed to utilize St. John's River. The report of the engineers that the canal would have to be 9 feet deep and the locks 250 feet long and 50 feet wide in order to admit the boats of the Mississippi—which dimensions were double those

[1]Fergus Crane, The Cape Cod Canal (Eclectic Mag. 146, 277-82).

planned—did not encourage immediate activity toward the realization of the proposal.

In 1852, Congress ordered a survey of a route which was to utilize the St. John's and Hillsboro rivers, whereby it was proposed to cut down the distance to 115 miles. The canal was to be 6 feet in depth and the locks 116 feet in length, and hence, the same objection applied to this plan as to the former. Several surveys were again made in the Seventies and the Eighties resulting in the claim that a canal with twelve feet depth could be constructed by following the Valley of the Oklawaha and connecting it with the lower part of the St. John's. This route would necessitate a canal fifty miles longer than the one proposed in the former survey, but it would shorten the distance across Florida by twenty miles. Since that time, there have been several congressional reports, but all their recommendations are based upon previous surveys.

This brief survey of the history and present status of the above canals brings out clearly several important facts. The financial condition of the canal companies has at no time during their history permitted them to enter upon plans for improvements providing for material enlargement of the canals beyond their original dimensions. Hence, since the beginning of the decline in the traffic in the Seventies, the companies have looked to the Federal government to assume direction and financial responsibility in all proposed improvements. The Federal government has accepted this responsibility to the extent of ordering numerous surveys which have been set forth in voluminous reports. But not a single step has been taken beyond this point, notwithstanding the fact that the reports have declared the proposed works entirely feasible.

The cause of this situation is quite obvious. The government is confronted with claims from all sections of the country. Many of these are worthy, but not all of them can be constructed at one time. It rests with the advocates of favored schemes to come to some agreement resulting in the selection of some specific improvements to be constructed at one time. This has not been done in the past, and as a consequence the government has doled out small sums to a vast number of schemes without any results. Nowhere is this baneful effect of particularistic action more clearly shown than in the methods employed during the last three decades toward the perfection of the Atlantic coastwise system by government

aid. This system presents a distinct unit, but up to the present time each canal company has pushed its claim separately.

However, we need not conclude this article with such a pessimistic view. On November 19, 1907, there assembled in Philadelphia delegates from all the Atlantic states to consider the question of united action for the realization of an inland water route from Maine to the Carolinas. On the following day, the conference formed a permanent organization called "The Atlantic Deeper Waterways Association." Several decisions of this conference are significant. They adopted resolutions advocating the construction of the entire system by the Federal government, and lamented the fact that the construction of the proposed Cape Cod Ship Canal had been left to private enterprise, while several of the delegates voiced the sentiment that the entire system should be free from the payment of toll. The association, however, showed that they were not prepared to recommend the completion of one link at one time, for they voted down the proposition that the Chesapeake and Delaware Canal should be converted into a ship canal before undertaking other works.

THE ANTHRACITE-TIDEWATER CANALS

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The coal-carrying canals were constructed during the period[1] of great national interest in the opening of water routes to the West. Unlike the larger projects, they were intended to supply transportation to a special interest, and upon the development of that interest—the coal trade—depended their whole prosperity. Their construction took place at a time when public interest in waterways was at its height. Into the history of each enters much of the speculative element which attended the construction of all the early projects for furnishing cheap outlets for the undeveloped national resources. With the advent of the railroad as a transporter of coal their operation was found less and less profitable, and they have gradually dropped out of importance as industrial agents.

It is the object of this paper to review the history of these waterways and to summarize the conditions which determine whether or not they may again become available under the new economic conditions which have developed or seem likely to develop.

The Delaware and Hudson Canal

The construction of the Delaware and Hudson Canal was authorized by the joint action of the legislatures of Pennsylvania and New York in the sessions of 1822-3. The company became a banking concern and a large landholder—the latter through the desire to control tonnage for its waterway.

The period in which the project was launched was one of great speculation in public improvements, and the stock was subscribed to the full amount by two o'clock of the first day on which the books were opened. The original plan had been for a canal and slackwater navigation, but an improvement, to consist of a canal alone, and finally of a canal and a railroad was substituted. The first through shipments of coal took place early in 1829. The

[1] The historical material used in this article is summanized from a monograph preface for the Carnegie Institution of Washington by the author.

Map of Susquehanna and Anthracite-Tidewater Canals.

coal was brought down to the canal from the mines at Carbondale at first by teams at a cost of from $2.25 to $2.75 per ton, later a substructure of timber faced "with rolled iron plates . . . . fastened . . . with screws" was used. The coal traffic on the canal in its early years received an important supplement from the general trade, which was a greater factor than on any of the other coal canals; but the income from it never equaled the running expenses of the waterway. The coal market was so limited that not until after the results of the panic of 1837 had disappeared was the company able to declare dividends. Then the trade necessitated the enlargement of the waterway—originally intended for thirty-ton cargoes, and it was improved to accommodate forty and eighteen-twentieths tons in 1844, fifty tons in 1846, ninety-eight tons in 1850, 140 tons in 1853. Meanwhile the railroad to the head of navigation had undergone several improvements to increase its capacity. In 1847 the first important contract was entered into to get the coal of other companies, thus greatly increasing both tonnage and tolls.

In the years following 1840 the company enjoyed a period of great prosperity. In 1843 all outstanding bonds were paid. By 1845 almost all the banking capital had been redeemed and the loans of credit by New York were canceled in 1848 and 1850. This left the company entirely free from debt. Soon after, however, the desire to expand to other markets led to the construction of railroads and to new bond issues. The greatest railroad expansion comes, however, after 1861, and up to 1865 the stockholders found their canal a rich source of income. How valuable a property it was may be judged by the following typical instances of dividends received: 1840, 11 per cent; 1847, 22 per cent; 1855, 18 per cent; 1858, 5½ per cent (due to railroad expenditures); 1860, 7 per cent; 1861, 9 per cent; 1862, 11½ per cent; 1863, 34 per cent; 1864, 31 per cent, and 1867, 16 per cent. The decrease after 1864 was due to the transfer of much of the tonnage to railroad routes. The prosperity was due in large degree—in fact mainly—to the toll on coal of other companies. The first contracts for this service were made in 1849, and soon furnished an important part of the income. By 1854 the tolls paid by the Pennsylvania Coal Company, the chief independent company, for the year amounted to $541,378.07.

An unfortunate dispute as to this traffic arose as to the tolls

chargeable after the enlargement of the canal. The contest was taken before the courts in 1856, and it dragged on until 1863, when the court gave an award for the Delaware and Hudson Canal Company amounting to $350,000. The legal victory was, in fact, a great economic misfortune. After the adverse decision the shipping of coal by the canal was cut off by the independent company, and its traffic turned to the Erie Railroad, which, in 1866, carried almost all the coal formerly sent over the canal by the Pennsylvania Coal Company. The diversion of this traffic dealt a deathblow to the prosperity of the canal. In the two years 1865 and 1866 the company lost more than the entire amount of their claim for extra toll, and the canal income fell from about two and a half times the expenses for repair and maintenance to a little over one-fourth of their amount.

At once the policy of the canal company was changed. An attempt was made to greatly extend their railroad holdings, and thus to win back the traffic they had lost and to obtain access to new markets. In 1867 a railroad outlet through Scranton was secured by the absorption of the Union Coal Company. Another company, with coal lands and a railroad connection across the Susquehanna, was purchased, giving an outlet to Baltimore and to Jersey City. In 1868 a contract with the Erie was made to build a line to give access to the Rochester and Buffalo markets. Other branch roads were provided for, and an exchange of stock with the Erie brought about the identity of interests of those two companies. The Albany and Susquehanna Railroad was leased in perpetuity in 1869, and further access to Baltimore acquired. Three years later the New York and Canada Railroad was put under construction to tap the Montreal market.

By the time of the panic of 1873 the company was in the full swing of the expansionist movement. Railroads had superseded the canal in the transportation interests of the company. How thorough had been this transformation in the five years since 1867 is shown by the fact that by 1872 all statistics of canal traffic disappear from the reports and the only regular mention of the canal is in the entry of canal tolls in the income sheet.

The history of the canal since 1872 is an uneventful one of decline and abandonment. The coal shipments were practically confined to those made by the company and fell off yearly. In 1897,

preparatory to final abandonment, a part of the canal assets were charged off to profit and loss and subtracted from the surplus. The following year the "managers . . . decided . . . to cease operating the canal, . . . the cost of transportation is too great as compared with other methods." Since then the damages made by freshets have not been repaired and "the cost of the canal . . . has been charged off and no longer stands as an asset."

The Morris Canal Company

Least successful of the coal carrying waterways was the Morris Canal—one which, even had railways not made competition by the route impracticable, would have had a hard time competing with the other water routes to the seaboard. The claims of the promoters of the enterprise were by contrast greater. They expected the Morris Canal to secure a monopoly of the trade of the west to New York, to control all the coal trade from the Lehigh region to tidewater and to develop along its route the greatest manufacturing district of the new world. The canal was first projected as a state work, but in 1824 was given to a private company. The physical difficulties to be surmounted were greater than in any of the other projects. The rise and fall to be overcome was reported as 1,730 feet, a forbidding distance, of which 1,470 feet must be overcome by inclined planes instead of locks.

The high tide of speculation at which the canal project was started brought offers of subscription of $20,000,000 to the $1,000,000 of stock offered in the spring of 1825. Public confidence soon fell away and by 1828 over one-third of the stock was forfeited through non-payment of assessments. The financial straits of the company were relieved by loans abroad, but the work dragged, and the first boat did not pass to Newark until the fall of 1831. Even after the canal was in working order it was difficult to borrow money to fit out boats for use thereon. Financial difficulties continued until the next period of speculation preceding the panic of 1837. Additions to stock authorized by the legislature in 1835 were eagerly subscribed for, the forfeited shares were easily sold at par, and in 1836 with this money the canal was completed to Jersey City. The directors boasted that in one year their financial operations had put the company in a position to discharge all debts "from their own capital and resources" and still have $1,000,000

for banking purposes. These finances, however, were largely concerned with "notes of other banks equal to specie," and when the panic of 1837 came it forced the company again into embarrassment.

A twenty-five ton canal, it was evident, was inadequate to maintain itself. Enlargement to a capacity of fifty-four tons was attempted, but while the improvement was still only under way the company was forced into bankruptcy, and in 1844 was sold to satisfy a mortgage.

The purchasers reorganized the company by consolidating the old common stock and issuing preferred upon which demands of 10 per cent were guaranteed. The new company continued the improvements on the canal and the enlargement of the planes which, when they were acquired, passed boats only at one-fourth the speed of the lift locks. Up to this time no development such as had been hoped for in the through coal trade to tide had taken place. In 1847 even, only 17,885 tons reached Newark, and upon all through trade there was no profit. An enlargement to seventy-ton capacity was next attempted. By 1856 most of the planes on the west slope, where the chief lifting was to be done, had been enlarged and a depth of five feet of water attained. At last the tide seemed to have turned—the canal had been quadrupled in capacity and boats could be passed carrying sixty-five to seventy tons. Shipping facilities on the Delaware were improved and arrangements made to get coal from the Lehigh Valley Railroad as well as from the Lehigh Canal. Finally, in 1859, the sale of the Delaware Division by the State of Pennsylvania to a private company made possible a combination as to toll rates which promised increased income.

The outlook for the Morris Canal at the outbreak of the Civil War was therefore more encouraging than at any other time during its history. The war period proved for it, as for other coal-carrying routes, a period of rich harvest. The total tonnage rose from 554,034 tons in 1858 to the highwater mark of 723,927 in 1864. More coal was offered than could be carried, though the boats were pressed to the limit of their capacity. The coal tonnage rose from 350,331 tons in 1859 to 459,175 tons in 1866, an increase which, with the rise in tolls, brought dividends never before or afterward approached in the history of the company. The highest profits were reached in 1864, when 10 per cent was paid on both common and preferred stock. The period of prosperity was soon

brought to an end. The railroads, heretofore the feeders of the canal, now became its competitors. This influence first began to be felt in 1866, when the Morris and Essex Railway began to supply with coal part of the territory formerly reached by the canal. To counteract the competition new enlargements were put under way and special inducements offered to boatmen to stay on the canal in the coal trade. But the rail rates, especially the rate wars, soon cut off all profits, and in 1870 the company asked the legislature for permission to lease the canal and its properties. Permission was granted. Early in 1871 the Lehigh Valley Railroad leased the canal and its important terminal facilities in Jersey City for 999 years. The subsequent service rendered by the canal has been a decreasing one. Only in two years (1883 and 1884) after 1870 has the tonnage risen above 300,000 tons. By 1888 the trade had become "almost exclusively" local. The flood of 1902 on the Lehigh finally closed the western end of the canal, and it is now no longer open for use except for the local trade and for coal delivered to it by railroad.

By its original size and by the physical difficulties to be overcome the Morris Canal was from the first seriously handicapped as a route for the through trade. The part it played was consequently a disappointing one.

The Delaware Division Canal

The object of this detached portion of the state works of Pennsylvania, unlike that of the system which was to tap the trade of the west, was to supplement works already under way—the Lehigh improvements, with which interests it has now become merged. It was thus built with the definite thought that its value should be found in service to the coal traffic. The waterway was constructed in the years 1827-1830, though navigation was still incomplete at the end of 1831. Faulty construction, bad judgment in determining the size to be given the canal and the interstate jealousies of New Jersey and Pennsylvania hindered the usefulness of the waterway. New Jersey was reluctant to yield the use of the Delaware as a feeder, and Pennsylvania forced traffic through an artificial route to Bristol for fear an outlet lock to the Delaware and Raritan would divert the profits from her citizens to those of New Jersey. The dimensions of the canal locks were but half

those of the Lehigh, and transshipment was thus necessary, or the use of small boats suitable to the Delaware. Recommendations that the canal be made uniform with the Lehigh remained unheeded by the legislature until railroad competition began to threaten both the New York and Philadelphia markets. Then improvements were put under way, but were not completed when the canal was sold with the other state works undisposed of, to the Sunbury and Erie Railroad in 1857.

An independent company took over the canal the following summer and operated it for nine years. The improvement begun by the state was completed, but due to failure to come to amicable arrangements with the other waterways the canal did not share the phenomenal prosperity enjoyed elsewhere during the Civil War. The lack of harmony finally brought a proposal to buy the canal from the Lehigh Coal and Navigation Company, which was accepted by the Delaware Division Canal Company in 1866.

The Lehigh Coal and Navigation Company

The plans to develop the mining lands on the Lehigh by means of a canal were developed earlier than the other projects already discussed. Indeed the Morris and Delaware canals were built largely as supplements to the Lehigh improvements.

Numerous unsuccessful ventures dating back as far as 1793 prefaced the successful completion of a waterway down the Lehigh in 1820. The coal was floated down in arks by means of artificial freshets. The tonnage grew rapidly, but was interfered with by the expense of constructing new arks for each trip, as they could not be returned up the river, but were broken up on arrival at Philadelphia. Since 1825 also an uninterrupted slackwater navigation had tapped the Schuylkill region. For these reasons an improvement of the waterway to a slackwater navigation up to Mauch Chunk was determined upon, especially as the state had committed itself to the improvement of the Delaware. The canal was able to accommodate boats of 120 tons by 1829. Upon the completion of the Delaware Division the use of arks was gradually abandoned and permanent boats substituted. In the years following 1835 other slackwater improvements were introduced above Mauch Chunk and a railroad was substituted for the highest portion of the route.

The extensions were hardly completed when a disastrous flood

almost wrecked the company in 1840. A few years put it on its feet, however, and the period 1840-1867 proved here, as on the Delaware and Hudson, one of exceptional prosperity, even the financial stringency of 1857, though it caused grumbling, did not cut down the dividend-paying ability of the company.

The coal tonnage, which had risen from 365 tons in 1820 to 225,585 tons in 1840, steadily grew to 1,276,367 tons in 1855. This was the period of the company's history during which its canal interests were most prominent in the minds of the managers. It was even planned to give up the mining of coal by leasing those properties and making the company a navigation company in a more confined sense. A change in this policy came with the year 1856, when the Lehigh Valley Railroad paralleled the navigation, necessitating reduction in toll rates and involving a diminution in tonnage. As a result the managers report in 1859: "The company must look for their remuneration to the augmented production of the mines . . . from which to derive a revenue." The importance of railroad connections was also increased.

During the Civil War the necessity for turning to lines of activity other than the exploitation of the canal was not emphasized to the extent it would have been but for the great increase in demand for coal which, notwithstanding the railroad competition, gave the canal more traffic than it was prepared to handle. Consequently the war years show profits unapproached before that time, though freshets, strikes and rate wars, and in 1862 a disastrous flood, cut down the profits that might have been reaped.

The Lehigh Company was not ignorant of the fact that the railway development in progress threatened its prosperity, and even in these years of exceptional dividends took steps to counteract the coming disadvantages under which it would have to work. Extensive coal lands were purchased, the smaller tributary railways absorbed and an extension of the Lehigh and Susquehanna Railway—till now a feeder to the canal only—was made from Mauch Chunk to Easton to compete with the Lehigh Valley Railroad. The company entered into the strife for tonnage and markets that absorbed the interest of the coal transportating routes in 1860-70. As a part of this policy the Delaware Division Canal was acquired in 1866. In making these extensions the corporation outran its credit, and in 1870 found itself facing the possibility of

a combination of the railroads across New Jersey, which would leave it without a rail outlet to New York. Both financial and strategic reasons counseled that an alliance be made with the Central Railroad of New Jersey, the only independent outlet remaining. For these reasons the railroad properties were leased to the Central Railroad of New Jersey in March, 1871, for a rental of one-third of the gross receipts on the line. For the time the Lehigh Company again became "a coal and navigation company . . . as during the period of (their) greatest prosperity." It had thus gotten rid of part of its financial responsibility before the panic of 1873. When that came the company was further embarrassed and was forced to sell its Wyoming coal holdings to a company allied with the Central Railroad, which latter corporation also leased all other properties of the Lehigh Company, including its two canals, in December 1873. This agreement removed the Lehigh Company from active business operations until 1877, when the Central Railroad went into the hands of a receiver, and the leased properties, with the exception of the railroad, were returned to the owners. The return was by no means a misfortune, for the lessees had expended over $1,100,000 in improvements upon the property which now returned to the owners without cost to them.

The relative importance of the company's properties had now changed radically. The majority of the capital was in the railroad—the rent from which formed the chief item of income. Next in value were the mines, and last, the canal. The canal tonnage since this period has gradually fallen with the increase of railroad connections to New York, the lowering of rates and the unfavorable terms granted on certain routes—notably the Delaware and Raritan Canal—making through trade in competition with the railroads unprofitable.

The success of operations is shown by the course of profits. From the time when the company again assumed control in 1877 up to 1884 the yield varied, showing a gradual increase up to $276,106.20 in the latter year. After that profits gradually decreased to 1893, when they reached $16,986.77. Since then there have been small profits and small losses on operation. A disastrous flood in 1902 necessitated increased repairs, and by cutting off tonnage helped to bring deficits.

At present the canal is operated with a tonnage of 240,151 tons (1906).

The Schuylkill Canal

The Schuylkill Canal is an intermediate term between the distinctively coal-carrying routes and the canals to tap the trade of the West. Originally planned with the latter object in view, its traffic was almost from the first chiefly coal. The construction for boats of twenty-five tons, with a depth of three feet, took place in the years 1818-25. In 1832, to accommodate the growing coal trade, it was enlarged to eighty tons capacity, and in 1845-47 to 170 tons. Even in the latter year, however, the coal traffic was only 6,500 tons. Beginning with 1832 the canal had a practical monopoly on the coal trade from the district it served, and for the next few years showed handsome profits. The stock rose to three and one-half times its par value, a figure till then unprecedented in the history of American joint-stock companies. The end of the prosperity of the route was foreshadowed in 1842, when the Philadelphia and Reading Railway was completed from the Falls of the Schuylkill to Port Richmond. This, with the other connections, gave a through rail route to the coal mines. The enlargement above mentioned and serious floods brought financial embarrassment, necessitating a reorganization of the company in 1852. In 1861 the Reading Railroad began to work for the monopoly of the trade by buying up the branch coal roads. The canal company adopted similar tactics and secured favorable tonnage contracts for ten years, and satisfactory dividends were again resumed in 1866-67. The independent existence of the canal company was brought to an end in 1870 by the continuance of the Reading's plan to capture the avenues of coal supply from the Schuylkill region to Philadelphia. The canal and its properties in this year were leased to the Reading for 999 years, at a yearly rental of $655,000. Since that time no important expenditures have been made to improve the canal, and through traffic has practically ceased.

Historical Review Summarized

In all of the waterways, the history of which has been reviewed, the main trade has been coal. The general trade has been negligible from the standpoint of profits, with the exception, perhaps, of the trade in iron ore on the Lehigh and Morris Canals.

The canals fall into two classes—the Morris and the Delaware

and Hudson; and the Lehigh, the Schuylkill, and the Delaware Division. The first group involved carrying all through freight over heights of land intervening between the ends of the waterways. The latter group takes the heavy freight offered downward only. These groupings also correspond to the availability of the canals as trade routes, in the past and in the future. From this point of view the situation of the Morris Canal is the least favorable. The physical difficulties to be overcome place it at a permanent disadvantage in comparison with the other routes, notwithstanding the location on the line from the coal fields to New York. In the present state of mechanical development the extended use of the inclined plane, even if the water supply could be increased sufficiently to support an enlarged canal, seems to be out of the question.

The Delaware and Hudson, except that inclined planes are not necessary, labors under similar disadvantages, but its ability to handle a large traffic is proved by its history. Its operation has been found unprofitable under present conditions, however, and the railroad interests in control do not look upon its rehabilitation as a practical matter. This is also the case with the Schuylkill route, though in this case there is no summit level to be overcome.

The Lehigh and Delaware Division Canals, now under one ownership, are in a different class. The physical conditions are more favorable and it is also to be noted that unlike the other two they are held by a company in which the development of the canals would not merely mean a supplemental outlet to a market already reached by its railroad holdings, but an independent access to markets now reached through agencies furnished by other transportation companies. These canals also have proved in the past their ability to handle traffic.

The Present Problem of Coal Canal Transportation

The problem of successful maintenance of a coal-carrying canal is the same as for other transportation routes—the securing of tonnage. This is difficult at present because of the high local rates charged on the railways which might prove feeders to the waterways. As a result the canals find it difficult to make a competitive rate such that they can compete with rail carriage on the through trade. The high local rates on coal shipped to the canals

form so large a part of the cost of carriage to market that the canals must work at a peculiar disadvantage, unless they can supply the tonnage directly from their own coal mines or over railroads under their control. When the competing railroad companies are also coal mine owners, it is evidently against their interests to establish local rates which would divert traffic from their own to the rival transportation interests of the canals.

Another disadvantage of canals is the necessity of transshipment, especially when the cargoes on the canals are of small size. Where the coal must be loaded from a railroad to a canal boat, and later from a canal boat again to a railroad car, the incident expense greatly cuts into the ability of the canal to compete. Where the second transshipment can take place into large barges, the disadvantage is not so great, especially as the canal boat will have the ability to come directly along side, and wharfage charges can be avoided.

The inability to market products during the winter is a permanent limitation on the use of canals. Where the business must for months be transferred to the railroads there can naturally not be the continuity of business relations that is so much to be desired.

The technical problem of reducing the fixed charges of canal maintenance and the delays of lockage is also important in determining whether the canals can again be made available. The fixed charges of attendance of lockmen and the repairs of locks form the largest single item of expense on an average canal of 100 tons to 150 tons capacity. This renders the decrease of the number of locks an important factor in cutting down cost of operation. Modern engineering is making possible the use of locks of much greater height than those now in place on canals of medium size, and if such could be introduced with profit, adopting a sixteen- or twenty-foot lift where now eight- or ten-foot locks are in use, an important saving could be made.

Locks of higher lift would also mean a great economy in time, for it takes only a small increase of time to fill or empty a lock of twice the usual present height. The great waste of time in lockage at present is consumed in getting the boat into the lock, not in raising or lowering the boat. The loss occasioned in checking a boat which is going into the lock too rapidly, or in starting one lacking momentum, and pulling it into the lock by hand or by

winches consumes many times the time necessary to do the actual work of lockage. Where short lift locks are used the time spent in lockage is often as great as the entire time spent in actually traversing the prism. Higher locks would therefore mean a decrease in the personnel and equipment necessary to operate the canal as well as increased earnings on the capital invested in boats, due to increased ability of each boat to take produce to market.

The most decided advantage of a canal is in the low cost of moving freight. Where speed is not an essential, as in the heavy and rough products, this may prove quite sufficient of itself to overcome disadvantages which would otherwise make operation unprofitable. The actual cost of moving freight—exclusive of lockage—on a 100-ton barge canal is somewhat less than one-half cent per ton per mile. If the barge is increased in size, the cost per ton mile is more than proportionately less.

Where the fixed charges of a canal are low, this advantage in towing cost becomes a very important feature. A canal whose fixed charges and towing expenses with barges of 100-tons capacity, on a freight total of 250,000 tons, give a ton mile cost of one and one-half cents, would give a ton-mile cost of one cent per ton-mile on 500,000 tons and three-quarters of a cent per ton-mile on 1,000,000 tons. Increase in the size of the barges, decrease in the number of locks, or in the cost of towage, would, of course, further decrease ton-mile cost. In the latter item experience with electric traction in Europe shows that there important savings can be made over animal power. Towing from the bank of canals of the character under discussion has proven less wasteful of power than towing by tugs. Further, the distinct advantage is gained that it is accompanied by less washing of the banks. These reasons also set the profitable limit of speed even when mechanical traction is introduced at four miles an hour.

Can Coal be Profitably Carried by the Canals under Present Economic Conditions?

The Morris Canal seems to be handicapped to such a degree that its abandonment may be accepted as final. Under present conditions the operation of the Delaware-Hudson route, once an important avenue of trade, has been found unprofitable, as already indicated, and there is no prospect of its further use in the near future. The same is true of the Schuylkill Canal.

Of the distinctively coal canals discussed, the only one in operation throughout its whole length is that furnishing an outlet by the Lehigh-Delaware route. This canal still carries a coal traffic of over 200,000 tons. During the past summer experiments have been introduced on the upper section with the object of finding whether mechanical traction can be introduced at a profit. Two experimental sections of two miles each have been installed. One section is operated by an electric device of the American Adhesion Traction Company; the other by a modification of the Lehigh Company's electric mine locomotive. All the traffic on both of these sections is handled exclusively by these machines, which run along the line of the old towpaths. They handle the traffic fairly well, and the expense of operation is less than that of animal power. Whether the fixed charges on the investment will overbalance this advantage cannot be stated as yet because of the short time in which the experiment has been in operation. Whether the canal can again prove itself able to furnish a profitable outlet for the coal trade depends upon the success of experiments of this nature and modifications to cut down the fixed charges, such as are mentioned above.

The Relation of the Canal to the Coastwise Inland Waterways

If the canal can again prove itself able to deliver coal at the Bristol wharves on terms equal to the rates offered by the railroads, it would seem to have an assured business, even under present conditions, for the following reasons:

(1) To the Philadelphia market—the one to which the canal first sent its traffic—the canal has immediate access. The size of the city makes the market to be supplied one capable of large development.

(2) If the coal can be brought economically to Philadelphia, even under present conditions an important trade southbound can be developed. This would necessitate transshipment to larger coal barges, but that charge could be borne without destroying profits. That this is the case is proven by the fact that the Reading Railroad finds it profitable to transship coal at Port Richmond from its cars to coal barges which it sends through the Chesapeake and Delaware Canal to the Baltimore, Washington and Norfolk markets. A profitable business has thus been built up in spite of the canal tolls involved on the Chesapeake and Delaware

Canal. If the Lehigh Canal could profitably bring coal to Bristol, this trade would be open to it also.

The possibilities of developing markets other than Philadelphia would be greatly increased should the present movement to improve the coastwise waterways be attended with success. The trade to the south would be on a better footing because of the increased capacity of the boats into which the transshipment could be made, and because of the abolition of canal tolls.

More important even than this would be the outlet again opened to the canal, through the Delaware and Raritan, to the New York market. This would be a revival of a trade which for years formed an important factor in the total business of the Lehigh and Delaware canals. In 1867, 472,751 tons of coal from the Lehigh region passed into the navigable feeder of the Delaware and Raritan. By the same route were sent, even as late as 1884, 238,756 tons. This trade represented in each of these years nearly twice the amount that reached Bristol for the Philadelphia trade.

At present the Pennsylvania Railroad interests controlling the Delaware and Raritan route maintain the charges at such a figure that no competition can be given to the railroads by the canal company on through coal trade to New York. Were the tolls abolished and the chanel widened this market, like that to the south, would be open to exploitation by those delivering coal by water.

The answer to the question of the future availability of the coal canals is therefore a double one. In the case of the Morris Canal its future availability seems highly improbable. In the case of two, and perhaps the four others, the problem is a technical one—whether the improvements of modern engineering can make their operation so economical as to make their use as a supplement to the railroads in carrying low-class freight a profitable one. Physical ability to handle traffic is proved by their history. Availability of tonnage, through the granting of competitive rates on the feeding lines, and economy of operation, are problems to be determined by the community of railroad and canal interests and by improvements in engineering. A revival in the near future seems possible on but two of the waterways—the ones carrying coal on the Lehigh-Delaware route.

THE NEW YORK CANALS[1]

By Professor John A. Fairlie,
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In the great revival of interest in internal waterways, it is significant, though not surprising, that the first work of great importance has been undertaken by the same state that inaugurated the internal improvements of the early nineteenth century by the construction of the first Erie Canal. Ninety years ago work had been commenced on what then seemed the stupendous project of De Witt Clinton, the result of which was to establish the commercial supremacy of New York City and to make the State of New York the most populous and richest state in the Union. Until forty years ago, the Erie Canal remained the all-important transportation route between the Great Lakes and the Atlantic. Since then, the canal traffic has declined in amount, and its relative importance has dwindled to a small fraction of its former significance. But there are reasons for believing that a considerable part of this decline has been due to the failure to improve the canals to meet the needs of modern conditions, and the State of New York has now undertaken the construction of a new barge canal system, which it is expected will meet the conditions of to-day and bring about a notable revival of water transportation across its territory.

An account of the recent history of the New York canals should be of service in any discussion of American waterways. And it is proposed in this paper to examine the later period of canal traffic, the causes of its decline, the plans for the new water routes, the present status of the construction work, and the probable effect on transportation, commerce and industry.

From the time of their construction until after the last third of the nineteenth century had begun, the New York canals held undisputed their position as the main transportation route from the lakes to the seaboard. As late as 1862 the ton-mileage of canal

[1]Cf. for fuller details articles in the Quarterly Journal of Economics XIV, 212 (February, 1900), and XVIII, 286 (February, 1904).

traffic was more than double the combined ton-mileage of the New York Central and the Erie railroads. And in 1866 the canal traffic comprised 60 per cent of the freight movement across New York State.

It is in the development of internal commerce since the Civil War that the decline of the canals is to be traced. As early as 1863 we may notice a decline in the flour traffic on the canals; but the other important items showed no falling off at that time, and, indeed, showed an upward movement in the years of expanding business from 1866 to 1873. But the railroads were now securing a share of the bulk commodities; and their freight traffic as a whole was growing at a much more rapid rate than the railroads.

In the years of depression following 1873, canal traffic began to show a positive reduction in volume. In 1876, but 4,172,129 tons were moved on all the canals, less than two-thirds of the traffic for 1872. The railroads, however, continued to develop their traffic, and in 1876 carried a total tonnage of 14,983,600 tons, more than three times the aggregate canal tonnage.

For the next few years canal traffic showed signs of revival, reaching a total of 6,437,656 tons in 1880. As some of the branch canals had now been discontinued, the tonnage for 1880 was, in fact, larger than the aggregate for the same canals in any former year. But this movement was only temporary, and by 1882 the total canal traffic was about 16 per cent below the maximum figure for 1872; while during the same decade railroad traffic had doubled, and the railroad proportion of grain receipts at New York had increased to 63 per cent.

In 1882 canal tolls were abolished, and the canals became free waterways, maintained by the state from general taxation. But this change did not produce any marked effects on the traffic, which remained at about the figures for 1882 until the end of the decade, while railroad traffic continued to increase. From 1890 to 1895 the canal traffic again declined to a notable degree, from 5,370,000 tons to 3,500,000 tons. Since then the tonnage has been approximately stationary, reaching a minimum of 3,138,000 tons in 1904, but rising again to 3,540,000 tons in 1906. Meanwhile, however, the aggregate freight tonnage on the New York railroads has continued to increase, until it has reached the enormous volume of over 100,000,000 tons, compared with which the canal traffic is insignificant.

Viewing the whole period from 1868 to 1906, the total canal traffic has declined from 6,442,000 tons to 3,540,000 tons. Of the several canals, the decrease in traffic has been most marked on the branch canals, discontinued in 1877, and on the Oswego Canal. The Champlain Canal has maintained its traffic to a larger degree than the others, having a tonnage of about 800,000 tons a year, compared with 1,120,000 tons in 1868. The Erie Canal has now approximately 2,000,000 tons a year, as against 3,346,000 tons in 1868.

When the canal traffic is compared with the railroad traffic, the decline of the former in comparative importance is unmistakable. While as late as 1869 the canal traffic, measured in ton-miles, was equal to the aggregate railroad traffic across the State of New York, at present the canal traffic is less than four per cent of the railroad traffic, and is less than one-tenth of the freight tonnage on either the New York Central or the Erie railroad.

The factors which have brought about this decline in canal transportation are, as usual in economic development, many and complex; and the different factors have been of widely varying importance. In respect to some important items of traffic—lumber and forest products, iron ore and coal—the change has been due largely to changes in the sources of supply,—the geographical relations of the raw materials and the markets being better suited to other lines of transportation than across the State of New York. With regard to other commodities—live-stock, fresh meats and highly manufactured goods—the rapidity of railroad, as compared with canal transportation, gives the former an unmistakable advantage. So far as these factors account for the changed conditions, they indicate a permanent advantage of the railroad over the water routes. But they do not give a complete explanation of the expansion of railroad traffic or the decline in canal traffic.

The decline in grain traffic on the canals, both in actual amount, and still more in the percentage of receipts at New York, cannot be explained by geographical changes in the source of production nor the importance of rapid transportation. The increase in receipts at Buffalo and New York—although less in recent years—shows that the route across the State of New York is still the most important for this traffic; and the decline of canal traffic here is due directly to the competition of railroads travers-

ing the same section as the canals. This competition has been possible because of the reduction of rail rates until they at times have been almost as low as those on the canals; and it has been urged that this situation demonstrates that even for bulky commodities, where there is no need for special haste, the railroads can permanently offer practically as low rates and better service than the canals, and thus offer superior accommodations for all classes of traffic.

Further investigation, however, shows that while, during the past forty years, the railroads have made constant and large improvements, both in their physical condition and in their methods of administration, the canals have in both respects remained practically at a standstill. The road beds of the railroads have been completely rebuilt, permitting the use of larger cars and more powerful locomotives, increasing manifold the trainload units and reducing to a corresponding degree the expenses for each ton carried. At the same time the railroad lines have been consolidated under the control of large corporations, which reduce the expenses of general management and permit more economical methods of business management on a large scale.

On the other hand, no permanent improvements of any importance have been completed on the canals for more than forty years; while in many respects they are practically the same to-day as when first constructed. The same style of boats and the same system of animal towage have been in use since the first canal was constructed; and the size of the locks and canal prism, which limit the size of the boats, has remained unchanged since the completion of the former enlargement in 1862. And the traffic on the canals continues to be handled by single boatmen or small companies, owning at best but a few boats, with too little capital to make use of labor-saving devices, or to furnish terminal facilities, with no organized methods of securing business, and without sufficient financial standing to encourage the patronage of large shippers.

From these considerations it seems clear that the decline of canal traffic has been largely aided by the failure to improve the canals to keep pace with the railroads. And it is at least worth while to examine the possibilities of a revival of water traffic, if the physical condition and business methods of the canals were brought to a modern basis.

In 1899, Governor Roosevelt, of New York, appointed a committee of prominent business men and practical engineers to undertake such an investigation, and to formulate definitely the future canal policy of the state. And it is the recommendations of this committee, presented to the state legislature in 1900, which form the basis of the new barge canal project that is now under construction. The report of the committee emphatically opposed the abandonment of the canals, and doubted the expediency of a ship canal, which in any case would be a work for the national government. After the study of various projects the committee urged the construction of what would be practically a new series of canals and waterways, with important changes from the old routes, which should be navigable by steam-towed barges drawing ten feet of water and having a capacity of at least a thousand tons, or four times that of the largest boats that could use the existing canals. Preliminary estimates of the cost were also presented.

This report was followed by an exhaustive study of the engineering features of the project and the preparation of more detailed estimates by the state engineer and surveyor, which were submitted to the legislature in 1901, showing a total estimated cost of $101,000,000. Had Mr. Roosevelt continued as governor, energetic efforts would probably have been made to secure further action at that time. But his successor, Governor Odell, was not prepared to urge the matter; and not until April, 1903, was a statute passed, providing for an issue of bonds to the amount of $101,000,000 for the new canal plans, if approved (as required by the state constitution) by popular vote. After an active campaign the election in November was in favor of the work by the decisive vote of 673,010 to 427,698.

The scheme thus authorized has usually been called one for canal enlargement or canal improvement; but these terms fail to indicate fully the character of the work. More than one-half of the new water routes will be through river channels and lakes, and the canal work involves the construction of entirely new channels and locks, in many places along different routes from the present canals. On the principal route, or the Erie Canal, from Lake Erie to the Hudson River, the new channel will follow the line of the old canal, in the main, from the Niagara River, at Tonawanda, to the neighborhood of Lyons. Thence it takes a new

route to the south of the Montezuma marshes, and in the Seneca and Oneida rivers and across Oneida Lake. Thence it crosses to the Mohawk River west of Rome, and then utilizes the bed of that river for most of the distance to Waterford on the Hudson. The new route removes the canal from the business districts of Rochester and Syracuse, but furnishes each of these cities with larger and better facilities for water traffic in the Genesee River and Lake Onondaga. The most important changes of level are at Lockport and Waterford. At the former a flight of two locks will replace the five now used; and at the latter, five locks, with a fall of thirty-four feet each, will take the place of the sixteen in the neighborhood of Cohoes on the old canal.

In addition to this main line, the Oswego River will be canalized from its junction with the Erie canal route to Lake Ontario, furnishing a waterway from that lake to the Hudson with only thirty-five miles of canal. The Hudson River will also be made navigable from Troy to Fort Edward; and from there a new channel will follow the line of the Champlain Canal to the lake of that name.[2]

On all of these routes a channel with a mimimum depth of twelve feet is to be constructed. On river sections the minimum bottom width will be 200 feet; on canal sections 75 feet. The locks, which are the principal factors in limiting the size of the vessels will be 328 feet in length and (by the latest plans) 45 feet in width. These will permit the passage at one time of two boats, each 150 feet long, 42 feet wide and drawing 10 feet of water, with a capacity of 1,500 tons; and such barges will be the most economical unit for transportation on the new routes. The size of the barges and the location of so much of the new routes in open water courses involves the disappearance of the primitive system of horse towage, and will make necessary the use of steam or other mechanical motive power. It is expected that vessels will usually go in fleets of four, one steamer towing three barges.

[2]Statistics of New Canal Routes.

	River and Lake. Miles.	Canal and Locks. Miles.	Total. Miles.
Erie Canal	174.83	167.83	343.66
Oswego Canal	18.04	4.80	22.84
Champlain Canal	38.18	28.16	66.34
Total	231.05	200.79	432.84

And under these conditions it is estimated that the trip from Buffalo to New York can be made in five days, in place of ten days as at present.

The estimates previously made covered in detail everything necessary for the construction operations, including not only excavation, locks and dams, but also bridges, harbors at Rochester and Syracuse, water supply, and navigation buoys and lights. The statute of 1903 authorized the letting of contracts, and directed the comptroller to issue bonds as needed for making payments. Careful provisions were made to secure public competitive bidding, and otherwise to prevent any mismanagement in connection with contracts. The governor was authorized to appoint a board of five expert civil engineers to advise the state officers during the progress of the work.

Following the popular vote, work was begun on the detailed specifications for contracts. Then bids were called for, and the first six contracts were made in April, 1905. Since then this work has been steadily continued. In December, 1907, contracts had been let covering 130 miles of the new routes, including twenty-eight locks and fifteen dams (out of a total of sixty-eight locks and thirty-three dams to be constructed), and aggregating $23,-000,000. These contracts have been for the most part at lower prices than the estimates of 1900; and the prospects are thus good for completing the work within the total estimated cost. The largest stretches of the new routes contracted for are one on the Champlain Canal from Northumberland to Fort Edward, and on the main route along the Seneca and Oneida rivers. But plans and detailed specifications are practically completed for contracts to cover most of the remaining sections.

Construction work on the contracts already let is well under way, and several locks, including one of the largest locks near Waterford, are approaching completion. But scarcity of labor has delayed operations; and it will probably be at least six or eight years before the completion of the whole plan can be expected.

As to the probable results of this new canal system, only general estimates can of course be made. It has been calculated, however, that the cost of transportation in barges built for the new route will be less than twenty-five cents per ton, or below half a mill per ton mile, far below the cheapest railroad rates. The

capacity of the canal will be about 30,000,000 tons a year; and on that tonnage the saving in cost of transportation as compared with the present canal would be $18,000,000 a year. Even with less than half the maximum tonnage, the direct saving will make possible a reduction in charges for transportation that will much more than offset the cost of the new undertaking.

But the direct reduction in the cost of transportation will be but a small part of the advantages from the new canals. And the indirect advantages, which cannot be even vaguely measured, will form by far the greatest economic gain, both to the State of New York and the country at large. Some of the tendencies that will be promoted may be at least indicated in a general way.

It is almost self-evident that the lower rates of freight by the new routes will prevent further diversion of the export trade in breadstuffs from New York, and will probably regain much of the trade already diverted to other ports, and re-establish the undisputed preeminence of New York in the export trade.

Of even greater importance are the possibilities in connection with the iron and steel industry. The raw materials can be laid down at Buffalo as cheaply as at Pittsburg,—the higher price for coal and coke at Buffalo being offset by the saving of rail haul of ore from Lake Erie points to Pittsburg. With an adequate waterway to the seaboard, iron and steel from Buffalo furnaces can be laid down for one-fourth of the present cost of carriage from the furnaces to the Atlantic. Opportunities will thus be offered for promoting the industrial development of western New York, for making New York harbor the distributing center for iron and steel products to the markets in the immediate vicinity, in New England and in foreign countries, and for developing on the Hudson River a large ship-building industry. It is not too much to say that the possibilities in these directions justify the comprehensive plans for the new canals fully as much as the prospect of transporting grain justified the construction of the first Erie Canal.

Nor is it impossible that, with the low rates of freight by the new canals, it will be found cheaper to ship west-bound coal by the indirect canal route than by the more direct railroad routes; and a large east-bound trade in bituminous coal to the manufacturing districts of New England may also be developed. Still more, it is at least probable that with the water routes now under con-

struction, regular lines of steamers can be operated at as great a rate of speed as freight trains, and secure no inconsiderable amount of package freight business.

And to conclude, the large barges in the new canal routes will easily be able to traverse Long Island Sound to New England ports, and to make journeys to the Delaware and Chesapeake Bay,—a prospect which opens up almost unlimited possibilities for through water transportation from the lakes to these distant regions.

TRANSPORTATION ON THE GREAT LAKES

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The prominence of the Panama Canal in the affairs of the nation has naturally resulted in greater interest in transportation by inland waterways. This is especially noticeable in the wider interest now being taken in our greatest natural waterway, the Northern Lakes, and in the conditions under which freight is handled on them.

Although the Great Lakes were originally individually navigable for boats of considerable size, the rapids at Sault Ste. Marie, and the narrow and shallow stretches of water connecting Lake Erie with Lake Huron, and Lake Huron with Lake Superior, through which the greatest volume of tonnage must pass, presented many obstacles to the passage of vessels. An increasing traffic transported, and a consequent decreasing cost of transportation have accompanied the clearing of these impediments to navigation. The principal natural obstacles have been, and still are, the shallow water over the Lime Kiln Crossing, just south of Detroit, over the St. Clair flats not far above the same place, at the Straits of Mackinac, and, most important of all, the Sault Ste. Marie Rapids at the entrance to Lake Superior. The deepening by the United States Government of the first three stretches, and the building by the United States and Canada of the largest locks in the world at Sault Ste. Marie, where there is a total fall of about eighteen feet in three-quarters of a mile, now permit the passage of practically all the immense tonnage to and from Lake Superior. These improvements have perhaps yielded greater returns to this country than many times the same amount invested in any other character of public improvements.

The aim of this paper is to describe in a general way the origin, character and method of handling the tonnage of the Great Lakes.

Traffic and Vessel Tonnage on the Great Lakes

Contrary to the general understanding this traffic consists of relatively few commodities, most of which are products of the mines, the forests and the grain fields, surrounding or lying beyond the Great Lakes. Iron ore and coal constitute the bulk of the tonnage.

The tonnage of ships and traffic passing the locks at Sault Ste. Marie gives the clearest index of the business handled on the lakes, though these figures do not include the tonnage passing between Lake Michigan and the East. Over one-third of the tonnage of ships under the American flag and half the steamers of 1,000 tons and upwards are on the Great Lakes, and last year the total tonnage of freight east and westbound passing over the Lime Kiln Crossing below Detroit, which would include the business of both Lake Michigan and Lake Superior to and from Lake Erie, amounted to over 70,000,000 tons in a season of 230 days. Over 25,000 vessels passed Detroit, an average of one ship every thirteen minutes, and 200 tons of freight per minute for the season. These figures exceed those of any navigable stream in the world. The records taken at the Sault Ste. Marie locks, indicate in a general way the character of this tonnage and the relative importance of the commodities of which it is composed. Last year the total freight through the Soo amounted to 51,751,080 tons, carried in 22,155 boats. It was valued at $540,000,000, and was divided in the proportion about 80 per cent eastbound and about 20 per cent westbound. The principal eastbound business was:

Iron ore, 35,357,042 tons; wheat, 84,271,358 bushels; other grain, 54,341,155 bushels; flour, 6,495,350 barrels; copper, 107,633 tons.

Westbound:

Bituminous coal, 7,728,255 tons; anthracite coal, 1,011,275 tons; general mrchandise, not comparatively heavy, but of relatively large value.

The larger part of the total is iron ore and coal, and the eastbound movement over-shadows the westbound in tonnage, and also in what is known as "bulk" freight; *i. e.*, ore, coal and grain as distinguished from package freight or general merchandise. The relation between the tonnage of the several classes of freight does not correspond with the ratios of the values. In 1905 it was

estimated that of the total value of traffic through the Soo during that year, the value of the iron ore and products of iron represented 27 per cent, cereals, 28 per cent, copper, 7 per cent, coal, both anthracite and bituminous, 5 per cent, lumber, 4 per cent, and all other products 28 per cent.

The total number of vessels on the Great Lakes early in 1907, with their gross registered tonnage, was as follows:

	Number.	Gross tonnage.
Sailing vesels	519	269,136
Steam vessels	1,844	1,841,438
Canal boats	480	50,599
Barges	209	73,259
Total	3,052	2,234,432

Deducting the canal boats, the number of vessels actually engaged in lake traffic was 2,572, and the gross tonnage 2,183,833. The percentage of sailing vessels is decreasing year by year, most of those now running are on Lake Michigan. In 1895 sailing vessels carried 30 per cent of the tonnage passing the Soo; in 1905 only 15 per cent. The craft on the lakes now range from the old boats of small size to the modern ore carriers made of steel, the latest of which are 605 feet over all, with sixty-foot beam, a depth of thirty-two feet, and a capacity of 13,000 tons. The barges referred to above are generally towed by steamers of the same line.

Iron Ore Traffic

The principal iron mining ranges are the Mesaba, Vermilion, Gogebic, Marquette and Menominee ranges, located in the territory adjacent to the western end of Lake Superior and in the upper peninsula of Michigan. The principal ore docks are located at Duluth, Superior, Two-Harbors, Escanaba and Marquette. The mines, as a rule, are located from ten to sixty miles back from the water, and the ore is hauled in specially constructed cars to the docks. These docks are so constructed that the cars from the mines are run out on them. The hoppers in the bottom of the cars are let down, and ore is discharged by gravity into pockets from the bottom of which iron chutes lead to the vessel lying alongside the dock. Through the hatches of the vessel the ore

is chuted by gravity into the hold at as many points as there are hatches. In this way very little manual labor is necessary. A cargo of 9,277 tons of ore has been loaded into the steamer "E. J. Earling" at Mesaba Dock No. 4, at Duluth, in seventy minutes or on an average of 7,288 tons per hour.

Just here we have the key-note of the transportation service on the lakes, which is to secure for each vessel the least possible delay at port of loading or of discharge and consequently the greatest number of round trips possible in a season. The average number of trips that a modern vessel is able to make from the head of Lake Superior to Lake Erie is usually estimated at twenty per season, although with good dispatch at terminals some boats may make twenty-five, and even more. Every additional trip in a season reduces the average cost of transportation, and the entire carrying trade is ever pressing to reduce delay, whether at terminals or en route. To the genius displayed in devising plans to accomplish this result is due in no small degree the record the lakes have made in affording the cheapest transportation in the world.

Based on records at the Soo, in 1905, the average distance that freight was carried was 833.3 miles. The average cost was .85 mill per ton per mile, as against an estimated average cost for rail handling of about four mills per ton per mile. Ingenuity in effecting dispatch of boats made it possible for the steamer "W. E. Corey" to make thirty trips between Duluth and Lake Erie ports during the season of 1906, and in that time to carry the enormous total of 302,000 tons of iron ore.

The chief iron ore ranges, and to a large extent the vessels engaged in this trade, are owned by the larger iron and steel companies of the United States. The United States Steel Corporation, through the Pittsburg Steamship Company, owns the largest fleet on the lakes, 101 vessels with an aggregate tonnage of 368,165 tons gross register, or about 16 per cent of the total gross tonnage on the lakes. *Next* to them is the Gilchrist Transportation Company, with sixty-two vessels of 190,890 tons gross register; the latter, however, is not allied directly with the iron and steel interests. The chief steel companies, in addition to the United States Steel Corporation, now having ships on the lakes to carry their ore are the Lackawanna Steel Company, the Jones and Laugh-

lin Steel Company, the Cambria Steel Company, the Tonawanda Iron and Steel Company.

The largest steamer on the lakes is the "Wm. B. Kerr," having a capacity of 14,000 tons of iron ore. She is the first of three sister boats, and there are others capable of handling from ten to twelve thousand tons.

The record cargo of ore is held by the steamer "Henry H. Rogers" from Escanaba to South Chicago, 13,333 tons, and over and over again this year greater cargoes of freight have been carried down the lakes than have ever gone out of the harbor of New York. The depth of water in New York harbor does not permit the largest ocean steamers to load to their full capacity, and the largest vessels are the fast passenger ships that carry but little freight.

The rate at which ore is carried on the lakes is practically fixed by the Pittsburg Steamship Company, owned by the United States Steel Corporation, which decides what rates these boats will carry for, and the price they will give others to carry the balance of the ore used by them. In 1907 it was seventy-five cents per ton from the head of Lake Superior to the ore dock on Lake Erie, and from Marquette seventy cents per ton; while from Escanaba to Lake Erie ports the charge was sixty cents per ton, and from Escanaba to Chicago, a haul entirely in Lake Michigan, only thirty-five cents per ton.

In 1906 the charge for unloading iron ore was twenty cents per ton, while vessels that required trimming in order to adjust their cargo, paid about three cents per ton for that service. A cargo of ore loaded in a modern ore carrier, however, does not require to be trimmed.

The docks for the discharge of ore, unless such ore is for some iron industry located directly on one of the lakes, are generally owned and operated by the railroads leading south and east from Lake Erie to the furnaces of Pittsburg and the Mahoning and Shenango Valleys, a distance of approximately 75 to 150 miles, or even farther, to the furnaces in Eastern Pennsylvania, where the ore is converted into iron and steel by the use of limestone and coke. Were it not for the necessity of using these articles in the manufacture of iron, and for the fact that iron ore, on account of the cheapness of lake transportation, is more economically

brought to the coke, rather than the coke to the ore, the center of these industries might be in the neighborhood of Duluth rather than at Pittsburg; and the tonnage handled on the lakes might be comparatively insignificant.

The docks are located at Ashtabula, Cleveland, Conneaut, Buffalo, Lorain, Erie, Toledo, etc., all on the south shore of Lake Erie, and handle about 86 per cent of all the iron ore carried on the lakes. The above points rank in importance about in the order named, the largest number of tons handled in 1906 being at Ashtabula, with a total of 6,833,852 tons. The amount of ore received at Lake Erie ports was, in 1906, 32,076,757 tons, as compared with only 17,014,076 tons in 1901, a fact which furnishes a clear idea of the increase in the iron ore trade during the past few years. The difference between the total output and the receipts at Lake Erie ports is understood to be in the ore for furnaces at Detroit and South Chicago. Practically the entire success of a dock for receiving ore from a vessel, like a dock for loading vessels, depends on the ability to unload quickly and cheaply, and place in cars the tonnage that is daily brought alongside the docks by the gigantic ore carriers so constructed as to permit the hoisting and dumping by the most modern appliances, both electric and otherwise, of the greatest number of tons per hour in order to accomplish the quickest possible release of the vessel and effect the maximum saving in the cost of operation.

The efficiency of the machinery for unloading is shown by the record of the "George W. Perkins," 10,346 tons having been taken off in four hours and ten minutes, or at an average rate of 2,582 tons per hour. Moreover, this record is being approximated in the unloading of all similar boats, and it is the ambition of the managers of every dock to hold the unloading record. The records are being lowered year by year, and often more than once in a season.

Grain Traffic

Next in importance to the management of the ore traffic is the handling of grain. This trade is participated in by all kinds and sizes of vessels, and consequently there is more fluctuation in grain rates than in those for any other commodity. Grain originates beyond the western lake ports and is brought there

by rail and placed in elevators. From the elevators it is shipped by vessel, generally to the ports of Lake Erie, the cost by lake being less than by rail. At the western lake ports elevators in connection with and often owned by the prominent eastern rail lines, receive the grain, and in due course load it into cars for export via eastern seaboard cities or for transportation to interior points. The rates per bushel for carrying grain depend absolutely on the number of boats available for the trade. Charters for the season, such as are made for ore in large quantities, are not characteristic of the grain-carrying trade. When grain is wanted for any particular vessel the rate depends on the supply of or demand for vessels; or, in other words, upon what happens to be the immediate condition or the number of the boats available at the time, or upon the desire of the shipper for immediate forwarding. The rate thus made per bushel for forwarding say, to Buffalo, is known as the "going rate," and is a matter of public information on the various boards of trade at the points of shipment and remains the standard until altered by a change in the conditions above mentioned. The average rate on wheat from Chicago to Buffalo was 1.7 cents per bushel in 1906, and from Duluth to Buffalo 2.2 cents per bushel. Grain is the only commodity that is occasionally handled by what are known as the package freight lines, which are engaged in through traffic in connection with railroad lines. The boats of these package freight lines as a rule take grain only when it is necessary or expedient to fill out their freight capacity. At such times they bid for grain in competition with the bulk carriers, none of it handled by the package lines, however, is taken on through rates to interior eastern points, but only to eastern lake port elevators, from which the grain is reforwarded to ultimate destination.

In loading grain from the elevators it is spouted into the holds of the vessels through the hatches, and unloaded by placing an elevator "leg" through the hatches into the vessel. This so-called leg is a contrivance on which is arranged an endless chain of buckets which scoop the grain out of the boat, carrying it up and into the elevator.

The largest grain cargo in number of bushels carried but not in tons, was 417,300 bushels of oats brought into Buffalo by the "Mary C. Elphicke."

The rates on which grain is carried by railroad from the

eastern port elevator, if it goes to points east, are known as "At the East rates." This being a term used to indicate that the rate includes the cost of elevation from the vessel at eastern lake port and subsequent loading to cars, which service the ordinary rail rate would not include.

Lumber

Lumber is the other item of eastbound bulk freight on the lakes. The largest individual, although small, fleet in this trade is that of the Hines Lumber Company of Chicago. The rates this year have averaged, from Lake Superior to Lake Erie ports $2.25 per thousand feet, and from Lake Michigan to Lake Erie ports $2.00 per thousand feet. These rates are made by an association, with which practically all the lumber carriers are identified. The trade, however, seems to be falling off.

Westbound Coal Tonnage

Coal is practically the only article handled in bulk westbound. This business is peculiar in its method of handling, for coal is the only westbound cargo available for ore carriers, and were it not for coal these ore carriers would go light westbound, as they often do, in order that they may secure as many loads of ore as possible in a season. The result of this is that coal is taken west at rates that would otherwise be impossible. It is hard to estimate the value of this to the people of the Northwest, to whom the coal is a necessity. Coal is handled in and out of the ship without charge to the vessel, and last year the hard coal rate averaged, from Buffalo to Chicago, 46 cents and to Duluth 35 cents per ton. Soft coal averaged from Ohio ports to Chicago 46 cents and to Duluth 35 cents per ton. As practically all the ore boats are bound to Lake Superior the rates thence are lowest. Many of the big eastern coal companies have their own facilities and arrangements for handling coal at western lake ports.

Package Freight Service

We may now consider the relation of the package freight lines to the traffic of the lakes. These lines are engaged in carrying all kinds of merchandise in such packages and of such size as can be transferred from cars to boats. Practically all passenger

steamers on the lakes also carry package freight, although all package freight lines do not carry passengers, and in fact the big package lines, in operation between eastern and western lake ports, with perhaps few exceptions, do not carry any passengers, being made up exclusively of package freight boats. The most modern of these carry about 5,000 tons, and, as a rule, all of this is loaded between decks or in the hold reached through openings in the decks, the freight being handled in and out through gangways in the sides of the boat and up and down gang planks from and to the docks.

There are several package freight lines, but they may be divided into two large classes:

First. Those that make short runs between nearby ports or ports on the same lake, or are engaged in carrying freight, generally not of considerable volume, for local delivery at the ports at which they call.

Second. Those lines that have through rates and prorating arrangements with the larger eastern and western rail lines, with which they connect.

The lines in the first class, on account of the generally local aspect of their service and of the fact that they are not usually a link in a through transportation service, may be passed over without discussion, in order that fuller consideration may be given to the other and more important class of package freight lines.

Although the business carried between ports on the Great Lakes by these lines is considerable in quantity and value, their chief traffic is that turned over to them as intermediate carriers between the rail lines leading east to the western lake ports of Chicago, Milwaukee, Gladstone and Duluth, etc., and west to the eastern lake ports of Buffalo, Erie, Cleveland, Detroit, Port Huron, etc.—this business to be again turned over by the lake lines to rail connections at the end of their route. To illustrate by a concrete example: business for rail and lake shipment may be taken in New York by the Pennsylvania Railroad to Erie and delivered to its lake connection, the Erie and Western Transportation Company, which takes the freight by water to Duluth or Chicago, as the case may be, and again turns it over to connecting rail lines to be delivered by them to consignees at St. Paul or Minneapolis. The same service may be performed in the other direction from Minneapolis, for example, to New York.

As these lines all have their rail connections, they may in turn be subdivided into two classes, according to the efficiency of their service. Some of them have direct routes, east of the lakes, for example, to and from New York, in connection with the big trunk line roads, such as the Pennsylvania Railroad and the New York Central, while others are dependent on a short water haul, like the National Despatch which takes business by water from New York to New London, Conn., and there turns it over to the Central Vermont Railroad, which in turn has a long haul in connection with the Grand Trunk to Depot Harbor, Canada, where it is at last delivered to boats to be carried to Chicago and points beyond. Another route is via canal boat through the Erie Canal from New York to Buffalo (requiring from twelve to fourteen days on the canal), where the freight is turned over to lake lines for forwarding west.

Rates by the Lake Lines

As a result of the different services thus offered there are three kinds of rates via the lakes: (1) westbound, from New York City, known as standard lake rates; (2) differential lake rates, and (3) canal and lake rates. These three are represented by the following rates in cents per hundred pounds, on the various classes, New York to Chicago:

	1	*2*	*3*	*4*	*5*	*6*
Standard Lake	.62	.54	.41	.30	.25	.21
Differential Lake	.52	.46	.35	.26	.22	.19
Canal and Lake	.42	.36	.29	.23	.21	.18

It will be seen how complicated must be the adjustment of rates by the various routes, and how greatly the charges must vary in accordance with the services performed, particularly when it is remembered that the service between these points is also performed by all-rail routes, differential rail routes, and by an ocean-and-rail route via Norfolk. These routes in turn have the following rates, first class, in cents per hundred pounds, New York to Chicago: all-rail, 75 cents; differential rail, 69 cents; ocean and rail, 65 cents.

During the season of open navigation a shipper in New York who wishes to forward a hundred-pound case of blankets to Chicago, has, among others, a choice of the following routes, in connection with each of which the charge would be in cents the amount mentioned: all-rail, 75 cents; differential rail, 69 cents; ocean and

rail, 65 cents; standard lake, 62 cents; differential lake, 52 cents, and canal and lake, 42 cents.

Prominent among the commodities handled by the package lines, westbound, are sugar and cement. The eastbound business, however, is the heaviest and consists almost exclusively of flour, mill feed and copper, with occasional deck loads of shingles, and now and then grain if the vessels are unable to secure a full load of package freight.

Ownership and Rail Connections of Lake Lines

As between the standard and the differential lake lines, much the more important are the standard lake lines operating between Lake Erie and Lake Michigan or Lake Superior ports. These lines are, with the exception of the Soo line, generally owned and operated by the eastern trunk lines, as feeders at their eastern lake ports. The railroad-lake lines are:

	Operating to and from	*Owned by*
The Erie & Western Transportation Co. (Anchor Line)	Lake Michigan and Lake Superior.	The Pennsylvania R. R.
The Western Transit Co.	Lake Michigan and Lake Superior.	N. Y. C. & H. R. R. R.
The Union Steamboat Line.	Lake Michigan	Erie Railroad.
Mutual Transit Co.....	Lake Superior	Lehigh Valley R. R. D., L. & W. R. R. Erie R. R. N. Y. C. & H. R. R. R.
Lackawanna Transportation Co.	Lake Michigan	D., L. & W. R. R.
Lehigh Valley Transportation Co.	Lake Michigan	Lehigh Valley R. R.
Minneapolis, St. Paul & Buffalo Steamship Co. (Soo Line)	Lake Michigan	Minneapolis, St. Paul & Sault Ste. Marie R. R.

None of these lines, with the exception of the Anchor Line, operate passenger steamers. Like the carriers of bulk freight, every effort is made by the owners of these lines to accomplish as many trips in a season as possible, and the boats are consequently, with the exception of passenger boats during the passenger season, not operated on any schedule but are turned as rapidly as possible. To accomplish this large warehouses are maintained at eastern lake

ports by these lines, in order that the cargoes of eastbound vessels may be immediately unloaded for subsequent shipment east. These warehouses are equipped with various devices to secure the greatest possible dispatch in the loading and unloading of boats, and in many cases separate houses are devoted to the east and westbound business. At the western lake ports the facilities for through business are provided by the delivering rail lines at whose terminals the package freight lines call for or deliver business routed in their care.

On account of the slower speed of handling and of the increased number of transfers incident to business shipped by rail and lake, as compared with all-rail, the rates are lower via the lakes than via the all-rail routes. The present difference is illustrated by the 17½ cent rate per hundred pounds on flour from Chicago to New York, via lake and rail as compared with 19½ cents per hundred pounds all-rail, and by the westbound rate of 23½ cents per hundred pounds, New York to Chicago, on sugar via rail and lake, as compared with 26 cents per hundred pounds all-rail. The difference between these figures, in each case, is known as a differential. It represents the amount under the all-rail rate charged by the standard rail lines, which experience and long custom has established as being considered the difference between the value of the two kinds of service. The retail prices of granulated sugar and flour, per hundred pounds, being $5.50 and $3.50 respectively, it will be seen what a comparatively small part the cost of transportation must play in the price of such commodities to the consumer.

It is difficult to explain the various rates in existence over the several routes between the East and West; but it should be noted that the service via the lakes requires a transfer, where none is necessary when shipments are all-rail, and that there has grown up a fixed relation between the rates all-rail and the rates rail and lake, based on relative speeds, and that when reductions or advances are made in all-rail rates, consequent reductions or advances follow in the rates rail and lake, either eastbound or westbound. These principles of adjustment are further carried out in changes in rates by the differential rail-and-lake lines, and the canal lines.

The various standard lake lines were primarily considered as feeders for their rail connections, and in order that other railroads not equipped with lake lines may not reap the advantage of the

tonnage thus provided, through prorating arrangements have been made only between the lake lines and their rail owners, or such other railroads as the owners of the lake line think it profitable to connect with.

Summary—Importance of Service of Package Freight Lines

The foregoing discussion shows that by far the largest part of the tonnage of the lakes consists of ore, coal, grain, etc., handled in bulk by vessels ready to go from port to port for the highest compensation they can secure for their services. On account of the great quantities handled, and the ease with which it is loaded and unloaded, and also on account of the fact that the government has provided a free way and free harbors, the rates for transportation on the lakes are so low as to make unfair a comparison of those rates with average charges per ton per mile via rail lines.

The bulk freight handled on the Great Lakes consists almost exclusively of raw materials which can be moved at such low rates as to exclude competition by all-rail routes. With the package freight business the situation is different and there is active rivalry between the rail and water lines. The charges for package freight made by rail and water lines must be approximately equal because the difference in costs of the services by competing routes is relatively small.

Although the tonnage of package freight handled on the Great Lakes is small as compared with the volume of bulk traffic, the service performed by the package freight steamers is highly important. The package freight lake lines assist their rail connections by adding to the volume and regularity of their traffic, and afford the shipping public the choice between various routes. The shorter and more expensive routes provide a quicker service; the more circuitious, and to the shipper the less expensive routes, a slower service.

There is a business demand for both of these services. The package freight lines on the lakes perform a function of value to the carriers and to the public, and occupy an important place in the elaborate and delicately adjusted system of transportation that has grown up in the highly developed industrial section of the United States lying between the Mississippi River and the north Atlantic seaboard.

THE IMPROVEMENT OF THE OHIO RIVER

By John L. Vance,
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In a discussion of the improvement of the Ohio river, it will not be inappropriate to state at the outset the claims on which the six Ohio river states—Pennsylvania, West Virginia, Ohio, Kentucky, Indiana and Illinois—base their demands upon the general government for the canalization of the river from Pittsburg to its junction with the Mississippi at Cairo, a distance of one thousand miles as the stream meanders. The Ohio alone, of all navigable rivers in the United States, carries tonnage from its source to its mouth. It drains the richest valley in the civilized world; and the river might be of the greatest possible benefit not alone to the commercial, manufacturing, mining and agricultural industries of the six states, but of the greatest possible value to the trade and commerce of the United States, and, unquestionably, the greatest of all feeders to the Panama Canal.

The manufactures of Pennsylvania, West Virginia, Ohio, Kentucky, Indiana and Illinois, in 1905, amounted to $4,979,453,665 in value. Of that total Pennsylvania contributed $1,955,551,332; Illinois, $1,410,342,129; Ohio, $960,811,857; Kentucky, $159,753,966; Indiana, $393,954,305; and West Virginia, $99,040,076. The three crops of corn, wheat and hay were of the total farm value of $646,-090,621, with other crops in proportion. The wealth of the six states was $25,941,897,242, distributed as follows: Pennsylvania, $9,315,-140,116; Illinois, $6,976,476,400; Ohio, $5,019,004,453; Indiana, $2,-606,493,004; Kentucky, $1,365,130,718; and West Virginia, $659,-652,551. The total wealth of the United States was $88,517,306,775; the six Ohio river states contain approximately one-third of the entire wealth of the country, while the remaining members of the Union, forty states and territories, contributed the remaining two-thirds.

During the fiscal year ending June 30, 1905, according to the report of the Commissioner of Internal Revenue, the six Ohio river states paid into the Federal treasury not only one full half of all

internal revenue collected, but $16,000,000 in excess of that full half.

Such are the Ohio river states, which are demanding the canalization of the Ohio from Pittsburg to Cairo to a depth of nine feet. It is a demand made in the interests not alone of their trade and commerce but in the name of the trade and commerce of the entire country. It is a demand, primarily, it is true, of the Ohio river states—for they furnish the coal for the markets of the South; the coal and the natural gas that heats the furnaces and supplies the forges; that lights and heats the schools, the churches, and the dwellings. They produce the salt, the fire clay, the timber, the ores. They manufacture the pottery, the steel rails, the structural iron and steel, and finished glass and wood products of the country. They stand at the doors of the government confident in the justice of their demands, and in the knowledge that the benefit to them would be of immeasurable benefit to their sister states, especially to those of the great valleys between the Rockies and the Appalachian ranges, but also of immeasurable value to the trade and the commerce of all other sections of the country.

As early as 1804 the legislature of Kentucky incorporated the company organized for the purpose of constructing the Louisville and Portland Canal, with a capital stock of $600,000, for the purpose of aiding navigation by avoiding the falls of the Ohio at Louisville. Of the capital stock, 3,665 shares of the par value of $100 were held by the citizens of New Hampshire, Massachusetts, New York, Pennsylvania, Maryland, Missouri and Kentucky, with the Federal Government holding 2,333 shares. Although contracts were soon let for the work, it was not begun until 1825, and not until December, 1830, was the canal opened for navigation. During the first twelve months of its operation 406 steamboats and 375 flatboats, with an aggregate tonnage of 76,323 tons, passed through the canal, while for the month of July, 1907, the tonnage passing through the canal on steamers and barges was 1,100,533 tons. For the corresponding month of 1906 there were 805,672 tons. The canal was originally under state control, but is now under the control of the Federal Government.

About 1825 Colonel Long, of the engineer corps, in charge of the improvement of the Ohio, put into execution his plan of constructing wing dams, instead of the older plan of cutting channels

through sand-bars and shoals, and of that work Hall[1] says: "To cut a channel through a bank of sand would not be impracticable, but the excavation thus made would be filled up by the deposits of the next flood. About ten years ago Colonel Long, of the topographical engineers, was instructed by the government to make an experiment, and adopted the plan of throwing out wing dams from each side of the river, so as to confine the current within narrow bounds and to give sufficient volume to wash a channel for itself. He spent one summer in constructing such a work at Henderson, 200 miles below Louisville. The dams were constructed of piles driven into the sand and rising but a few inches above the surface. Not a trace of the work of Colonel Long remains to-day, and Hall well says that "the objection to any of these measures is that they have not been attempted on a scale of magnitude becoming their importance, and urged with all the energy becoming a great nation."

Wing dams were constructed at many points along the river. But experience demonstrated that they would not furnish the relief sought—would not maintain a sufficient stage of water to meet the demands of commerce. Dredge boats were brought into service, but they were found to be unavailing. Hence, the work of improving the Ohio languished. For many years the efforts in its behalf were sporadic and confined to local necessities, real or fancied. The sneer of Randolph, of Roanoke, that the Ohio was a stream which was dried up during six months of the year and frozen over during the other six months, together with "pork barrel" insinuations, not only stayed the improvement of the Ohio, but of all rivers. The coming of the railroad added to the neglect with which the Ohio, the greatest tonnage-bearing stream in the United States, was treated.

One important enterprise, however, was undertaken—the building of a lock and movable dam at Davis Island, about five and a half miles below Pittsburg. This dam was undertaken and completed for the purpose of furnishing a pool six feet in depth, in which towboats and barges might find safe harbor and be ready to take advantage of a "coal boat rise" and move down the river to the markets on the Ohio and the Mississippi. But this improvement was made in a half-hearted way, and with no belief that it would become

[1] "Statistics of West Cincinnati," 1836.

one in a chain of similar locks and movable dams that, when built along the river's entire length, would give a permanent and reliable depth of nine feet of water throughout the year. Appropriations for the Davis Island dam were slow; the work was prosecuted without energy. Finally, when completed, it was found to work successfully; the pool was formed, and the advantage of even this beginning of something "permanent" exceeded all expectations; but with the completion of this lock and movable dam, permanent efforts to improve the river practically ceased.

Whether it was because of the total inadequacy of the railroad as a means of transportation, or whether it was because of an awakening of the Ohio Valley to the immeasurable capacities of the Ohio river as a tonnage bearer is immaterial to the present purpose; the awakening came, resulting in the organization of the Ohio Valley Improvement Association, at Cincinnati, in 1895. Since that time there has been persistent and successful effort for the permanent improvement of the river to a nine-foot stage from Pittsburg to Cairo by a series of locks and movable dams.

At the first meeting of the association there were delegates present representing the mining, manufacturing, commercial, agricultural and the river interests of the Ohio Valley. They were men who fully realized that the permanent improvement of the Ohio to a navigable stage ample for the largest boats was imperatively demanded by every community and interest in the Ohio and Mississippi Valleys. The association has grown in numbers and in influence with the passing of every year. Annual conventions have been held regularly at important places along the river, the last one at Wheeling, W. Va., on the 14th and 15th of November, 1907.

The association at first was of the opinion that a six-foot stage would be sufficient; but experience demonstrated otherwise, and in 1902 the nine-foot stage became the platform of the association. It is gratifying to be able to state that the nine-foot stage has been accepted as the true standard of improvement of the Ohio, and the Congress of the United States is now irrevocably committed to it.

I have said that the Ohio is unique in the fact that it is the only stream carrying tonnage from its source to its mouth. It not only carries tonnage from its source to its mouth, but it supplies almost wholly the tonnage on the Misissippi from Cairo to New Orleans, for on the great Mississippi to-day there is no packet ply-

ing between St. Louis and New Orleans, nor any between Memphis and New Orleans, save the packets that steam out of the Ohio into the Mississippi.

Of the work that has been done for the permanent improvement of the Ohio since the organization of the Ohio Valley Improvement Association in 1895, only a brief summary can be given. The first important action by Congress was an appropriation for the survey and fixing of sites for locks and movable dams from Pittsburg to the mouth of the Muskingum river. This was followed by a survey of like character from the mouth of the Muskingum to the mouth of the Big Miami. By these two surveys it was found necessary to construct and sites were fixed for thirty-seven locks and movable dams.

On this stretch of river, covering about one-half its entire length, appropriations have been made for the prosecution of the work on more than one-third of the locks and dams. The first six, immediately below Pittsburg, including Davis Island dam, are practically completed; locks and dams numbered 8, 11, 13, 18 and 37 are nearing completion; land for locks and dams numbered 7 and 19 has been secured, and partial appropriation for work on 19 has been made; full appropriation ($1,200,000), cash and contract, has been made for No. 26, below the mouth of the Great Kanawha and Gallipolis, and the engineers are now engaged in final surveys to fix the exact location. The locks and dams named, below No. 6, were provided for by reason of the fact that they were considered of first importance. With the completion of No. 37 (about ten miles below Cincinnati) a harbor nearly thirty miles in length will be made, which will be of supreme importance to Cincinnati and her large interests. When No. 26 is completed the product of the coal fields of the Kanawha Valley may be transported to the markets of the Ohio Valley regularly by lowering the wickets on the Kanawha River and those of Nos. 26 and 37, thus flushing the river and giving the required water.

By direction of Congress the survey of the Ohio was completed from the mouth of the Big Miami to Cairo by a board of United States engineers composed of Lieutenant-Colonels Lockwood, Sears and Ruffner, and Majors Zinn and Sibert. Statistics of the tonnage of the Ohio were collected and tabulated at the request of the board, by the Ohio Valley Improvement Association.

The report of this board was filed in the War Department on the 4th of January, 1907, and was referred to the board of engineers for rivers and harbors, commonly known as the board of review. The report will no doubt be presented to Congress at its approaching session.

It is probable that the greatest work accomplished by the Ohio Valley Improvement Association was in its invitation to the Committee on Rivers and Harbors of the House of Representatives to make a tour of the Ohio from Pittsburg to Cairo on the steamer Queen City, commanded by Captain J. F. Ellison, secretary of the association and also secretary of the National Rivers and Harbors Congress. The trip was made in daylight, and covered ten days. That the tour was a source of the most valuable information to the committee is undoubted, and the fact was fully and most cordially conceded by all of the number. That it was productive of great good to the work in which the association is engaged is equally undoubted. The committee saw, from source to mouth, a magnificent river 1,000 miles in length, with steamers not only passing down stream laden with merchandise, but steamers alone, and with barges coming from local ports and from New Orleans and other southern points loaded with sugar, molasses, cotton, lumber or material for pulp mills—a stream on which coal and iron and other heavy products are carried at the phenomenally low rate of one-third of a mill per ton per mile; a stream on the banks of which, from Pittsburg to Cairo, there was an endless panorama of mining and manufacturing operations; a valley than which none is richer in agricultural products in the United States. They saw a stream which, during the fiscal year ending June 30, 1906, carried—according to official reports—more than 4,500,000 passengers and more than 15,000,000 tons of freight; a river on whose waters, not always navigable in their unimproved state, the steamer Sprague, the leviathan of western waters, took in safety from Pittsburg to Cairo, and from Cairo to New Orleans, in one tow of coal, no less than 70,000 tons—a tow of freight which would require not less than 2,333 coal cars, making a train fifteen miles in length, not including the locomotive engines required to draw it. They saw a river which, more than any other river in the country, has demonstrated that it is not present tonnage carried that determines its merits or its standing before the Committee on Rivers and Harbors

of the House, but that it is the tonnage-bearing capacity of a stream improved that determines its standing.

The benefits that have come with the completion of each lock and movable dam on the Ohio accrue to every mine and factory in the valley. With the completion of the nine-foot stage from Pittsburg to Cairo, the valley of the Ohio—the very heart of the commercial and industrial life of the country—would not depend solely on railroads for transporting the ores from the mines nor on the finished product from the factories to the markets. To-day the merchant, the farmer, the manufacturer, and the miner find the value of their products at zero too often because of inability of the railway to furnish him transportation to a market—for the value of the article of commerce is measured by its ability to reach a market. With the Ohio permanently improved, merchant and manufacturer, miner and farmer, would have ready access at all seasons of the year to a market, and the consumer would profit none the less than the producer.

MISSISSIPPI IMPROVEMENTS AND TRAFFIC PROSPECTS.

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The execution of the proposed improvements and extensions of the waterways of the Mississippi Valley will necessitate eventually the expenditure of hundreds of millions of dollars. To determine whether such an expenditure will be warranted, it is necessary to examine the problems involved in the undertakings, the cost of the improvements and their values as determined from an estimate of the lands reclaimed, freight rates saved and traffic secured.

Problems of River Regulation

In presenting the results of such an inquiry, a general discussion of the present obstacles to the free navigation of the Mississippi and the agencies which will assist in the improvement of the river, irrespective of the great projects now proposed, will precede the detailed study of the particular sections of the river.

Thus far, the frequent shifting of its channels, the sappings of its banks, the building of bars, the setting of snags and sawyers, the destruction of landings by the changing elevations of the water, and the interference of levees, bridges and other engineering works, have checked all efforts to increase the river traffic to meet the general industrial growth of the Mississippi Valley.

Each year an average of four hundred million tons of sediment is carried down to the gulf, occasioning great difficulties in controlling the stream. Bars are formed by the silt; and, by the deposition of the coarser débris, the river's course is dammed. The floating sediment scours the channel and wears away the obstructing banks with any acceleration in the current of the stream. As much of this sediment comes from the headwaters of each of the tributaries of the Mississippi, the main river can never be cleared until adequate provision is made for clearing

these tributaries. The sediment-free streams can then be made tractable for navigation and their power convertible for industrial purposes.

In the effort to clear the Mississippi the establishment of forest reserves and national parks will also be helpful. The forests, by conserving the rainfall, will check the tendency of the mountain streams to gather in torrents and carry into the headwaters of the tributaries vast quantities of sediment. Even the fringe of willows or beds of cottonwoods along each smaller stream will aid much if the local authorities will encourage their retention.

The municipal system of waterworks can be made, to a greater extent, a part of the general plan for clearing the river and improving the navigation. Each waterworks reservoir is a settling basin and the control of the catchment area checks soil wash and minimizes the amount of sediment carried by the stream. A definite and comprehensive system of co-operation between the national and municipal governments in the furtherance of every system of waterworks is yet to be established.

As more people see how irrigation incidentally reduces storm-floods and thaw freshets and retains much of the contained sediments, there will be a fuller appreciation of the fact that the irrigating and reclamation of the western lands will do much in bringing under control portions of the Mississippi river system. The above shows how important it is even from the standpoint of navigation, to adopt, as suggested by President Roosevelt in his recent Memphis speech, "a single comprehensive scheme for meeting all the demands so far as possible at the same time and by the same means."

In the endeavor to protect the flood plains the close connection which the improvement of one section of the river bears to that of another is very evident. The lower Mississippi during the period of its early settlement occasionally shifted its channel and, running over broad bottom lands, fixed in time its position by building natural levees of silt. Then again it broke through these barriers.

With the increase in population in the upper basin of the river and the reckless practice pursued of destroying the belts of timberlands along the rivers and running the furrows down slope regardless of soil wash, the quantity of sediment in the lower

river was augmented, the clogging of the channels was hastened, and the devastation by floods increased. In order to protect the millions of fertile acres of cane, corn and cotton the levee system was inaugurated. Upon this millions have been spent until now, in 1907, about 75 per cent of the banks of the river south of Cape Girardeau are leveed.[1]

The Mississippi River Commission, in their report of 1906, recommended the completion of the levee system. There are, however, some general difficulties involved in the work. As the waters of the river are confined within narrower limits, a vertical expansion of the water must occur. Therefore the levees must always exceed in height by two to four feet the highest known elevations of the waters. It is always possible that the next flood may be higher than any previous one. Some engineers tell us that if the river be contracted between rigid walls, the velocity of the stream will be so increased that up-stream navigation will be impossible and down-stream dangerous.[2] Others maintain that the sand bars and the sinuosity of the river are nature's provision against the violence of the stream.

Improvement Authorized in River and Harbor Bill, 1907

Three lines of procedure for the improvement of the Mississippi are designated in the recently passed River and Harbor Bill:[3]

(1) Appropriations were voted for the general improvements of the river, for the extension of the levee system and the improvement of navigation. This includes the maintenance of a navigable channel for at least 200 feet in width and 9 feet in depth from Cairo to the gulf.

(2) Appropriations for the improvement of the river from the mouth of the Ohio to the mouth of the Missouri.

(3) The appointment of a board to report on the practicability and desirability of constructing a navigable channel fourteen feet deep and of suitable width from St. Louis to the gulf either by the improvement of the river or by a canal or canals for a part of the route.

For study the river may be divided into three sections: (1)

[1]Chief of Engineers' Report, 1906, Pt. II, 2485, states that nearly 4,960 miles of levees had been built up to May 1, 1906.

[2]Cong. Records, p. 2168.

[3]H. R. Bill 24,991.

The lower Mississippi northward to the mouth of the Ohio; (2) The middle section, from Cairo to the mouth of the Missouri;[4] (3) The upper Mississippi, north of the Missouri.

The Lower Mississippi—The Levees

In the lower Mississippi navigation is impeded by shifting channels, destruction of the banks and the deposition of snags and sediments. The results obtained from dredging have fully established the fact that it is entirely feasible to maintain a channel 9 feet in depth and at least 250 feet wide at all stages by means of a suitable equipment of dredges. Success, however, rests upon an uninterrupted prosecution of the work which can only be secured by the government's continually appropriating the necessary funds. To secure the confidence of the capitalist who must provide the money for building the river craft and the steamboat man who navigates, an adequate channel must be maintained for a period of years.

In the reclamation of the valuable lowlands much levee work remains to be done, as was demonstrated by the flood of 1903. One-fourth of the Yazoo basin was under water, one-half of the City of Greenville, Mississippi, inundated, six thousand people driven from their homes and traffic suspended on the Yazoo and Mississippi Valley Railroad for twenty days, and on the Riverside Division for forty.[5] As the levee grows in volume, the loss per mile from the carrying away of its banks becomes more and more serious and, if the same rate of destruction continues,[6] the time will come when the annual revenues will not be sufficient to build new levees to replace those that cave in. It will, therefore, be necessary to continue the appropriations at an increased ratio for a number of years. The caving of the levee banks occurs in the bends, and the action takes place at intervals. The damage can be stopped only by revetment or by building a new levee on ground further from the river. The first method is so expensive that it is not favored by the commission except in a few cases: when the levee threatened is so situated that a new location cannot be formed except at a great distance from the river, where extremely valuable

[4]Twenty-eight miles north of St. Louis.

[5]Miss. River Com. Report, 1904, p. 23.

[6]Since Dec., 1903, 17 per cent of the total length of controlling line has been abandoned. Cong. Records, 41, Pt. 3, 2385.

interests would be sacrificed by the changed line, where there is a lake, an impassable swamp or a town lying immediately behind the present levee which would be thrown open to the flow by the change.[7]

To prevent the bends being cut off is another object of revetment. The importance of this phase of the work is seen in the disastrous effect of a cut-off where the bend is, say, fifteen miles around and one mile across. As the fall in the river is about six inches in a mile we would have, where the cut-off is made, a fall of seven and one-half feet in a mile, disturbing the existing conditions for forty to fifty miles above and below. Experience has shown that this shortening would be only temporary as the river would begin to eat in the offshore and in a very few years the length of the cut-off would be reached. This makes it imperative that both shores shall be protected.

But the higher levees, required for the confinement of the flood discharges from Cairo downward, will necessitate the expenditure of an amount of money which will be more and more beyond the ability of the riparian communities to bear. Although it now costs about $200,000 a mile for revetment work, it is estimated that if the government would undertake energetically, on a large scale, the revetment of the uncompleted portions of the five hundred miles of caving banks from Cairo to the mouth of the Red River, it would cost less than fifty million dollars. This completed, less money would have to be spent in dredging.

There is yet much work to be done in the New Orleans Harbor. Here an ever-present danger of a sudden collapse in certain portions exists. Ample funds must be provided for the extension and completion of the revetment.

The Middle Section of the River

For the middle section of the Mississippi River, the plan of 1881 arranged for the confinement of the flow to a single channel, having approximately a width of 2,500 feet below St. Louis. The secondary channels were to be closed and new banks built out where the natural width was excessive. For this purpose permeable dikes or hurdles of piling were to be used to collect and hold the solid matter that is carried in suspension or rolled on the bottom

[7] Cong. Records, 41, Pt. 3, 2385.

of the river.[8] In 1896 the plan was modified by substituting dredging as the method of clearing the channel, and by 1903 dredging plants were established.[9]

In the River and Harbor Bill, as passed, only $250,000 was voted for the work in this section of the river. Mayor Burr and others state that it will take all of that amount to keep the dredges going with nothing left for levee or revetment work.[10] The sum of $650,000, as recommended by General Mackenzie, Chief of Engineers, as the amount to be expended for the fiscal year ending June 30, 1908, was plead for in both houses of congress, but was rejected by the Committee on Rivers and Harbors of the lower House.

The objections to the larger appropriations were stated by Chairman Burton[11] of the House Committee on Rivers and Harbors. They were: (1) More money had been spent on the Mississippi River within the last twenty years per annum than is expended by Germany on the Rhine, whose traffic is thirty to forty million tons a year, while the total traffic of the middle section of the Mississippi dropped from 1,260,000 tons to 440,000 tons in the last ten years. (2) Extensive plans of improvements were adopted in 1881 at an estimated cost of $16,000,000. This proved ineffectual. After twenty-three years nearly eleven millions had been expended, when the estimate for the completion of the work was given as twenty millions, four millions more than the original estimate. (3) For nearly three years there have been eight feet of water, the amount now sought, yet traffic is diminishing. For the year 1904 and the three years previous $650,000 a year was provided. (4) Freight rate from St. Louis to New Orleans on grain is only one-third more per ton mile to-day than it is from Duluth to Buffalo. With this low rate practically no grain is shipped from St. Louis to New Orleans.[12] (5) Until it was determined whether or not the proposed deep-water channel from Chicago to the gulf necessitated canalization along the middle section of the river, it was unwise to expend more money for the section.[13]

[8] Engineer's Report, 1906, Pt. I, 462.

[9] Engineer's Report, 1904, 2144, *et seq.*

[10] Cong. Records, 41, Pt. 5, 4095.

[11] They were stated in the House, reiterated in the conference with the Senate Committee and re-stated before the Senate by Senator Frye Feb. 27, 1907. See Cong. Rec., 41, Pt. 5, 4088.

[12] Cong. Records, 41, 2429 (Feb. 11, 1907).

[13] *Ibid.*

Lakes to Gulf Waterway

Closely associated with the improvement of the middle section are the projects for the fourteen-foot deep-water channels from Chicago to St. Louis and thence to the gulf. Chicago, having completed the drainage canal with a view to its navigation, desires to secure its utmost efficiency by inducing the general government to complete a deep-water channel to St. Louis. United States surveyors have estimated the cost of a fourteen-foot waterway from Lockport, the terminus of the drainage canal, to the mouth of the Illinois River as a little over 23½ million dollars.[14] The Illinois law providing for the drainage canal, stated that whenever the United States Government shall improve the Des Plaines and Illinois rivers, making them capable of receiving a flow of 600,000 cubic feet per minute and assume all damages arising from any extra flow above 300,000 cubic feet per minute, the drainage canal shall be likewise enlarged and turned over to the general government for navigable purposes.

Certain difficulties are to be noted in the plan for the general government's undertaking the project. At a recent meeting of the Rivers and Harbors Committee at Niagara Falls, both the president and chief engineer of the sanitary district board stated that to carry off the sewerage of Chicago, a flow of 840,000 cubic feet per minute would be required.[15] In 1905-06, when the flow from the drainage canal was but 250,000 cubic feet per minute, 224 lawsuits were brought against the trustees of the sanitary district of Chicago and damages claimed amounting to $4,409,180. What damages the government will have to assume when the necessary 840,000 feet of water is turned in, is not known.[16]

How the level of the Great Lakes will be affected by this flow, is another problem. The enormous expense then of dredging the lakes can only be avoided and their present level maintained, by placing dams and other controlling works across the Detroit and Niagara rivers. This can be done only at great expense and after an international agreement.

Important water rights have been developed along the route

[14]Report upon Survey of Des Plaines and Illinois Rivers, 1905, p. 10. House Doc. 263, Fifty-ninth Cong., First Session.

[15]Cong. Rec., 41, p. 2299.

[16]Report upon Survey of Des Plaines and Illinois Rivers, 1905, p. 12. See also Cong. Rec. 41, p. 2299.

of the proposed deep-water channel by private corporations. In furthering the plans for the improvement of the rivers for navigation, it is necessary to cause the relinquishment of these rights. The State of Illinois is at present meeting with considerable opposition in its endeavor to remove the dams which obstruct the work upon the portion of the deep-water channel in which the state is interested.

The deep-water project from Chicago to the Mississippi will necessitate the enlargement and deepening of the channel from Grafton to St. Louis, or else the building of a lateral canal connecting these points. Engineers are not yet agreed as to the practicability of the canalization of the Mississippi. The Committee on Rivers and Harbors was undoubtedly wise in holding up the work to await the development of other projects and to give the engineers time to study the problems further in the hope of a closer approach of unity in the recommendations.

The Reservoirs of the Upper River

The upper Mississippi has certain unique projects. The principal one is the construction of reservoirs at the headwaters of the river, between Brainerd and Grand Rapids, Minnesota. These are planned to collect the surplus water from precipitation of the winter, spring and early summer to be systematically released during the navigable season so as to benefit the navigation of the river below.

A present difficulty in the efficient management of the reservoir system, as now constructed, is the great distance of the reservoirs from the head of navigation at St. Paul. Trouble arises in getting the water down to St. Paul in time to make good a sudden decrease in the natural flow at that point. To remedy this, use is made of the small available supplies in Sandy Lake and Pine River. To secure a much larger supply, which is needed, it is proposed to build other reservoirs which will deliver to St. Paul several billion more cubic feet of water from a point 103 miles nearer.[17]

The reservoirs affect seven different interests which often conflict; the steamboat navigation below and above St. Paul, logging, mills at and above Minneapolis, riparian owners on the river

[17]Engineer's Report, 1906, Pt. II, p. 1438.

and those on the reservoirs. Each is unquestionably better off with than without the reservoirs; in fact the supply and regulation of water secured by the system greatly benefit the 434 miles of navigable river between Minneapolis and Cass Lake.

The different interests affected by the reservoir system selfishly desire it to be managed exclusively for their own benefit. Owing to this fact the consideration and settlement of the various complaints against the system constitute at present a problem in the improvement of the upper Mississippi. These complaints came from three sources: (1) Riparian interests above the dam; (2) the flooded district in the vicinity of Aitkin, Minnesota; (3) the milling interest at Grand Rapids, Minnesota.

Of the first, it may be said that the reservoir system does flood the lands, and the fluctuation in the water surface thus occasioned results in damage. Consequently, the government must acquire the land overflowed, purchase the right to overflow it, or pay damages for property destroyed. In acquiring the right to overflow the land, the government is performing its full duty in the matter.

In extending and completing the reservoir system, the government came into dispute with the Indians in the Leach Lake Reservations. These Indians have resorted to growing wild rice and hay around the reservoirs. Although the government paid them $150,000[18] for the right to overflow their land, a fair compensation, they, naturally improvident, continue to depend on additional government aid.

Besides the complaints of the Indians, dissatisfaction has arisen among those financially interested in the lumber company at Cass Lake. The J. Neils Lumber Company, organized after the United States Government had secured the flowage rights on the lands occupied by the company's mills, feel entitled to damages by the overflow because they were not notified of the government's right when they bought the land. Though complaints come to the engineering board from other localities, the government seems to be adjusting equitably every legitimate outstanding claim.

A general demand to abandon the reservoir system comes from those impressed by the loss occasioned by the withdrawal of the land from settlement and the permanent obstacle to its development.

[18]Act Aug. 19, 1900.

However, the benefits to the various interests below the dam are so great that, even if the flowage lands above were vacated by the government, the advantages to the community at large could never be so important as those secured by the reservoirs.[19]

A few words regarding the situation at Aitkin, Minnesota, will aid in understanding the problems met in the improvement of the river at that point. Owing to the low banks, flat slope and excessive curvature of the Mississippi in this section a very fertile area of 100,000 acres is subject to overflow. The flood of 1905 caused an actual damage of $50,000 and such dire indirect losses that the government of Minnesota called for relief contributions. A number of farms were abandoned and the crops for an entire season over a large tract of country were destroyed. The people of Aitkin, rejecting the engineer board's statement that the cause was the exceptional rainfall, firmly believe that the reservoir system occasioned the disasters. Hence the engineer board must now convince the people[20] of the real cause and make all possible alterations in the system to appease them.

The great paper industry of Grand Rapids, Minnesota, with its mills about two and one-half miles below the Pokegama reservoir dam, complain of insufficient water to run during the non-navigation seasons. It appears that the company located its mills and constructed its mill wheels with the view of taking advantage of the reservoir system. But now it is found that the requirements for navigation, the main purpose of the system, do not always coincide with those of the mill. The whole contention of the paper company amounts to this: that the government shall abandon the purposes for which the reservoirs were built and convert them into mill ponds, for the benefit of the company. In this clash it is clearly shown that the interests above the dams can never be equally as well served as those below. The lower interests are much more important and must take the precedent. However, to secure the largest amount of support for its method of improving the upper river, the government must do all in its power to treat the paper industry with the utmost liberality. This it seems to be doing, although at present obliged to reject the radical demands of the Grand Rapids interests.

[19]See Engineer's Report, 1906, Pt. II, 1464-70.

[20]See Engineer's Report, 1906, Pt. II, 1459-64 for careful examination of the question.

The River from St. Paul to St. Louis

From St. Paul to the mouth of the Missouri River, the improvements consist of the removal of snags, some dredging and such special harbor and levee work as is needed. Originally the channel between these two points was such that in low stages the larger boats were unable to proceed farther up stream than La Crosse or Winona. The present project for the improvement of this section proposes a contraction of the waterway so as to afford a channel of sufficient width and a depth of four and one-half feet at low water, to be eventually increased to six feet by further contraction. For the last few years such a channel has been secured. Expenditures are still demanded in order to obtain an increased depth at certain points and make the necessary repairs to dams and shore protections.

It has now become the fixed policy of the Committee on Rivers and Harbors to recommend no appropriations for the improvement of any waterway until the tonnage of the section shows sufficient magnitude. Furthermore, there must exist reasonable grounds for expecting that such an amount of the tonnage will follow the waterway as to make the business returns therefrom commensurate with the expenditure for the improvement.

Water Power—Upper River

Thus far, the advantages derived above St. Paul from the reservoirs have been largely such as accrue to the floating of logs.[21] In time the logging interests will relinquish the river to navigation and large quantities of merchandise will be transported to market from the upper regions which are not reached by railroads. With the completion of the locks and dams now being built, Minneapolis will become practically the head of navigation on the river.

The storage capacity of the five reservoirs, constructed and maintained by the government at a cost of $1,250,000, is 96 billion cubic feet of water. It is estimated that each billion cubic feet is at present worth to the milling interests of Minnesota $13,000 a year or a total of $1,218,000. The total valuation of water-power development in operation on the Mississippi between Minne-

[21]Traffic between Grand Rapids and Brainerd, Minn., in 1905, was 460 tons of freight and 1,586,000 tons of logs, valued at $5,436,000. Engineer's Report, 1906, II, 1440.

apolis and the reservoirs is now about $225,000. Additional powers worth $900,000 are being built about Minneapolis while others amounting to nearly $3,000,000 are under consideration. It is maintained that the reservoir system has already directly benefited the milling interests of Minneapolis to the extent of $500,000; for, here over 16,000,000 barrels of flour are produced yearly by water power at less than one cent a barrel, while by steam it would cost five cents.[22]

River Traffic and Rates above St. Louis

For the year 1905, 4,089,319 tons of freight passed between St. Paul and the mouth of the Missouri River.[23] Up to June 30, 1906, the government had spent $11,673,356.76 on improving this portion of the river, and $660,000 for maintaining the improvements.[24] At first sight the expense might appear entirely out of proportion to the traffic, but, by the great saving in freight rates, the expenditure was well made.

In 1905, the railroads on both banks of the river from St. Louis to St. Paul charged 50 per cent more than the steamboats; while the railroad rate to an inland point, having no water competition, but about the same distance from St. Louis, was 200 per cent higher.[25] There can no longer be any doubt that water rates have a controlling influence upon railroad rates. Abundant proof of this is given in the table on page 158.[26]

It is difficult to overestimate the vast possibilities for manufacturing industries in the upper Mississippi Valley. Wisconsin alone with its 1,400 lakes and rivers represents immense potential power. This power, conserved and increased, will vastly augment the amount of manufactured merchandise which must seek exportation.

One may reasonably doubt the assertion of Governor Van Sant, of Minnesota, made in 1904, to the effect that with a six-foot stage in low water, practically all the flour for export in Minneapolis will find an outlet down the Mississippi to the gulf.[27] The average freight rate on wheat from New Orleans to Liverpool for

[22]Engineer's Report, 1906, II, 1470.
[23]*Ibid.* I, 465.
[24]*Ibid.*
[25]*Ibid.* 466.
[26]Report of the Upper Mississippi River Association, 1905, p. 167. See similar table in Report, 1902.
[27]Proceedings of Upper Mississippi River Improvement Association, 1904, p. 49.

FREIGHT RATES SHOWING COMPARATIVE BASIS BETWEEN POINTS HAVING WATER COMPETITION AND INLAND POINTS WHICH DO NOT OBTAIN THE BENEFIT OF WATER RATES.

From	To	Miles.	Route.	Classes.				
				1	2	3	4	5
St. Louis ...	St. Paul, Minn.	573	Rail	$0.63	$.052½	$0.42	$0.26	$0.21
St. Louis ...	St. Paul, Minn.	729	Boat	.40	.34	.27	.17	.14
St. Louis ...	Oklahoma City, O. T.	543	Rail	1.30	1.09	.97	.84	.67
St. Louis ...	Dubuque, Iowa	340	Rail	.45	.37	.29	.23	.18
St. Louis ...	Dubuque, Iowa	439	Boat	.33	.26	.20	.15	.10
St. Louis ...	Topeka, Kas.	347	Rail	.89	.69	.54	.42	.32
St. Louis ...	Quincy, Ill.	140	Rail	.32	.27	.21	.15	.10
St. Louis ...	Quincy, Ill.	161	Boat	.26	.22	.17	.12	.08
St. Louis ...	Moberly, Mo.	148	Rail	.50	.39	.29	.23	.18
St. Louis ...	Hannibal, Mo.	120	Rail	.30	.25	.19	.14	.09½
St. Louis ...	Hannibal, Mo.	141	Boat	.23	.18	.14	.10	.07
St. Louis ...	Mexico, Mo.	110	Rail	.43	.34½	.26	.21	.16
St. Louis ...	Burlington, Iowa.....	214	Rail	.44	.35	.26	.18	.12
St. Louis ...	Burlington, Iowa.....	249	Boat	.33	.26	.20	.13½	.09
Quincy, Ill...	Kansas City, Mo.	226	Rail	.60	.45	.35	.27	.22
St. Louis ...	Peoria, Ill.	165	Rail	.25	.20	.16	.12	.11
St. Louis ...	Poplar Bluff, Mo.	166	Rail	.52	.44	.36	.31	.26
St. Louis ...	Cape Girardeau, Mo. .	131	Rail	.25	.20	.15	.12½	.12½
St. Louis ...	Salem, Mo.	127	Rail	.46	.39	.32	.28	.23
St. Louis ...	Memphis, Tenn.	305	Rail	.65	.50	.45	.35	.30
St. Louis ...	Hickory Valley, Tenn.	302	Rail	.96	.82	.67	.55	.45
St. Louis ...	New Orleans, La.	705	Rail	.90	.75	.65	.50	.40
St. Louis ...	Terrell, Texas	669	Rail	1.37	1.21	1.04	.96	.75
New York ..	Chicago	913	Rail	.75	.65	.50	.35	.25
Chicago	New Orleans	923	Rail	1.10	.90	.76	.58	.47
Chicago	Kansas City	458	Rail	.80	.65	.45	.32	.27
New York ..	Chicago (Lake and Rail)	......	......	.59	.51	.40	.20	.25

the years 1899-03, inclusive, was 6.55 cents per bushel, while from New York it was only 3.97 cents.[28] In 1905 the rate for flour from New Orleans to Liverpool was 15 cents per hundred pounds, while from New York it was 5.63 cents.[29]

The grain and flour required in the internal trade of the Mississippi would seek the improved waterway. In addition there would be an up-stream traffic in lumber, sugar, molasses, rice and imports from Asia and South America. The hardwood lumber in such demand in the furniture factories in the Middle West could be transported on the river.

The claim that coal will be brought down the Ohio and up the Mississippi can be believed; that it will be carried clear to St.

[28] Digest of Hearings on Regulation of Railway Rates, Senate Doc. No. 244, Fifty-ninth Congress, First Session, p. 498, 493.

[29] *Ibid*, 498, 501.

Paul and Minneapolis, may be doubted. A greater amount of this coal could reach Wisconsin and Minnesota towns by the improved waterways. The problem of coal transportation is always complicated by the fact that railroads will often carry coal to the distant Northwest at a great sacrifice in order to secure a return cargo. At present it is hauled from Ashtabula, Ohio, to Duluth by water at the rate of thirty-five cents a ton so as to secure a return cargo for the iron ore vessels.

In spite of all the statistics of the traffic upon the upper Mississippi, no great amount of actual commerce is shown. As yet this section of the river does not have the amount naturally belonging to it. To some extent this is due to the uncertainty of its navigation, making it impossible to induce capital to build the necessary steam crafts. Commerce did not come to the railroads until they were completed, and it will not come to the river until the improvements are made.

Traffic Below St. Louis

The tables on page 160 give the statistics regarding the traffic on the middle and lower section of the river:

For the fiscal year ending June 30, 1904, the three great railroads between Chicago and St. Louis transported 449,115 tons of freight to St. Louis and returned with 633,182 tons, making a total of 1,082,297 tons in both directions.[30] Though far short of the amount moved in 1906, this indicates, to some extent, what a share the projected deep waterway to St. Louis might have in the traffic. The meats, cereals, hardy fruits, manufactured merchandise made from iron and steel, and the furniture of the Middle West will seek the new route in reaching the southern states. In return the tobacco, rice, nuts, and lumber will be sent to the north. All non-perishable goods of small money value in proportion to their weight will go by water rather than by rail. Then, too, the waterway can carry the raw materials for building and manufacturing purposes which a more costly means of conveying would leave untouched.

With the completion of the deep waterway from the lakes to the gulf, the Lake Michigan traffic would have a route to the

[30]Engineer's Report of Survey of Des Plaines and Illinois Rivers. House Doc. 2, 63, Fifty-Ninth Congress, First Session (1905-06), 15.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1905.[31]

[Report of the Chief of Engineers, U. S. Army.]

TABLE I.

Tonnage Between—	Number of passengers.	Receipts and Shipments, in Tons.					
		Grain and its products.	Cotton.	Cotton seed and its products.	Live stock.	Coal and coke.	Lumber.
St. Louis and Cairo.....	61,232	50,441	1,991	912	21,048	131,756	21,143
Cairo and Memphis.....	41,696	51,123	9,573	11,069	200	1,328,930	242,076
Memphis and Vicksburg.	114,179	47,960	66,556	64,699	4,091	1,097,758	128,697
Vicksburg and New Orleans................	84,225	26,881	25,349	39,554	3,945	1,080,075	33,203

Tonnage Between—	Receipts and Shipments, in Tons.					
	Logs.	Iron, steel and metals.	Groceries and provisions.	Stone, sand and gravel.	Miscellanous and unclassified.	Total.
St. Louis and Cairo.........	101,111	135	18,958	....	69,526	417,021
Cairo and Memphis	486,051	55,153	4,844	5,800	43,550	2,238,363
Memphis and Vicksburg.....	334,499	16,409	30,471	1[illegible],336	*45,354	1,855,830
Vicksburg and New Orleans.	233,388	24,062	86,833	526,852	†382,932	2,462,974

* Includes 4,742 tons of oil. † Includes 259,296 tons of oil.

NOTE.—Each stretch is treated as a separate river, and tonnage carried between ports on different stretches will appear in the statistics of all intervening stretches. Consequently the sum of the tonnage carried in the four stretches does not represent the total traffic on the river as a whole.

TABLE II.—RECEIPTS AND SHIPMENTS AT PRINCIPAL PORTS.

Ports.	Passengers carried in and out of port.	Receipts and Shipments, in Tons.					
		Grain and its products.	Cotton.	Cotton seed and its products.	Live stock.	Coal and coke.	Lumber.
St. Louis, Mo...........	*961,618	24,497	1,991	855	21,017	125,755	21,132
Memphis, Tenn.........	73,744	12,362	26,724	18,786	2,217	132,419	18,067
Vicksburg, Miss†........	60,583	35,889	42,158	47,665	719	53,803	14,414
New Orleans. La.‡......	21,967	733,866	583,090	390,147	7,522	1,053,204	345,100

Ports.	Receipts and Shipments, in Tons.					
	Logs.	Iron, steel and metals.	Groceries and provisions.	Stone, sand and gravel.	Miscellaneous and unclassified.	Total.
St. Louis, Mo..............	64,323	135	17,146	7,000	86,574	370,425
Memphis, Tenn	200,800	989	10,044	....	61,637	484,045
Vicksburg, Miss.†...........	72,500	33	13,865	3,000	15,593	299,669
New Orleans, La.‡	298,858	78,836	794,946	6,756	§802,513	5,104,798

* Includes 832,590 passengers in local excursion traffic.
† The traffic with the Yazoo River and its tributaries not included.
‡ Includes exports and imports and the domestic coastwise traffic as far as reported.
§ Includes 262,793 tons of oil.

[31] Engineer's Report, 1906, II, 2514.

ocean closed only 22 per cent of the twelve months in the place of the present waterway which is blocked with ice 40 per cent of the year. The wholesale merchants are practically barred, by the prohibitory railroad freight rates, from the territory south of the Ohio River both east and west of the Mississippi. The coming improvements of the Ohio, Cumberland, Tennessee, Red and Arkansas rivers will open the entire South to the northern trade.

With an improved Mississippi and the deep-water channel made to Chicago, a lively contest may be waged as to which route the grain from St. Louis will take for exportation to Liverpool. The average rate charged for the years 1899-1903, inclusive, from St. Louis to Liverpool via New Orleans, was 10.99 cents[32] and via New York it was 16.33 cents.[33] For the same period the rate from Chicago to Liverpool via the lakes and the Erie Canal was 9.15 cents.[34] If the improved Mississippi will make a corresponding reduction in the rate via New Orleans that the deep waterway will occasion via New York, grain will continue to go to New Orleans from the St. Louis market. In 1905, the flour rate from Kansas City to Liverpool via New York, rail, lake and canal, was 30.24 cents per 100 pounds, while it was only 26.15 cents via New Orleans.[35] With an improved Missouri, Mississippi and the deep-water channel to Chicago the grain from Kansas City might have a choice of two routes.

Upon the completion of the Panama Canal there will be a vast increase in the traffic moving southward to the gulf. With the deepened upper Mississippi, the channel connecting the Mississippi with the Great Lakes via the Illinois River, and the improved channel from St. Louis to the gulf, the Middle West will be put into direct communication with the cities of the Pacific Coast as well as with those of Hawaii, the Philippines, Japan, China, and western South America. A saving of between 8,700 to 8,946 miles will be made between Chicago and San Francisco and Asiatic ports via the Mississippi and the Panama Canal. The central part of the Middle West will be 590 miles nearer San Francisco and other Pacific ports than New York. The people of South America are already purchasers in United States to the extent of $40,000,000

[32] Hearings on Rail. Rates, p. 498.
[33] *Ibid.*
[34] *Ibid.* p. 493.
[35] *Ibid.* p. 505.

a year, and a great share of this is from the Middle West. Every effort is being made to secure more of this trade at the expense of Germany.

When direct water communications are established between the Mississippi and South and Central America so that vessels loaded at South American ports can, without breaking bulk, discharge their cargoes at ports on the upper Mississippi or the Great Lakes, an inestimable increase in the trade of the Central West will occur.

Summary

Some idea of the magnitude of the difficulties involved in the improvement of the Mississippi has been given. The necessity of awaiting for full reports and estimates before inaugurating the greater projects has been shown. Sufficient evidence has been presented, however, to establish the fact that the improvements will be of great value. Added emphasis is given to this when the congestion of freight in all parts of the country in 1906 is recalled. James J. Hill asserted that it would take 73,333 miles of railroads, constructed during the ensuing five years, and costing $5,500,000,000 to relieve the situation. Railroad corporations have since met with such difficulties in securing capital during the past two years as to delay even modest extensions of their lines. Relief can come only by the government's undertaking a national system of improvement of its navigable waters. It is the best way that can be adopted for further regulating rail rates and assisting in extending the transportation facilities of the country.

As a business proposition it will pay great returns if the rivers are made freight carriers and rate regulators.[36] The census report of 1900 states that the cost of transportation on all railroads of the United States averaged 7.5 mills per ton per mile, on the Ohio River to Cincinnati .32 mill, and on the lower Mississippi .1 mill. If James J. Hill's statement be correct that railroad transportation cannot be performed at much less than one-half cent a ton per mile while by steel barge freight can be carried on a deep channeled river at the cost of one mill, then water navigation will continue the cheapest for a large class of commodities.

[36]Cong. Records 41, p. 2280. Speech of Joseph E. Ransdell in House of Representatives, January 31, 1907.

But the friends of the Mississippi River improvements must remember that similar arguments are at present being advanced for the improvement of many other rivers in the country.[37] Every effort must be made to intensify the spirit of co-operation which has exhibited itself in recent conventions. A solid majority must be secured in the next Congress in favor of much larger appropriations for the various meritorious projects, and the work must be inaugurated upon a broad national basis which will make adequate provisions for improvements in every section of the country or failure will result. In that event the Panama Canal even will not enable us to maintain our commercial position among the nations of the world.

[37]See Debates on recent River and Harbor Appropriation Bill in Cong. Records 41, also Proceedings of National Rivers and Harbors Congress, 1906.

WATER-POWER IN THE MISSISSIPPI VALLEY[1]

By Mr. Calvin O. Althouse,
Instructor in the Department of Commerce, Central High School, Philadelphia.

The first period in the history of manufacturing in the United States was that in which the streams of New England gave sites to small villages with single factories dependent upon water-power. During a subsequent period, coal was the concentrating factor. Industrial development in the near future will again depend largely upon water-power. But that water-power is a resource which man can easily dissipate has not yet struck home. The advantage of electricity as a means of transmitting and applying power so developed is furnishing a mighty stimulus to this development.

It has been estimated that in the South the slopes adjacent to the Appalachian highland are capable of developing 3,000,000 horse-power, and that in three states, North Carolina, South Carolina and Georgia, more than 90,000 horse-power has been developed in cotton mills alone. A tremendous aggregate of power is dispersed along the upper water of the streams and their hundreds of tributaries which find outlet into the Ohio and Mississippi rivers. In estimating the resources of the region, all these smaller powers should be counted in, for they can supply power for local industries, for lighting small towns and for transportation on local lines.

In the highlands which send their streams precipitously into the Tennessee, the Cumberland and the many other streams merging into the Ohio and finally the Mississippi, two general plans of improvement suggest themselves for utilizing the water:

(*a*) By building high stone and concrete dams, 20, 50 or even 100 feet high across the narrow gorges with wheel pits at or near the dam, and the construction of power houses immediately above the wheels. In this manner a fall of water equivalent to the height of the dam is obtained, and the steep descent of the channel below the dam assures the quick removal of the water from beneath the wheels.

[1]The paper discusses the possibilities of developing water-power in the Mississippi Valley, and locates many of the power sites, but not all of them.—Editor.

(*b*) Constructing lower dams, and conveying the water either through open canals or closed pipes for a distance along the banks of the stream until a sufficient fall can be obtained, at which point the power house is constructed.

In mountainous regions generally, many of the available sources are remotely situated and not within easy reach of railroads or good wagon roads. Again, in many instances, the gorges are so narrow and the country so rough that the local conditions are not favorable to the establishment of adjacent manufacturing plants. Hence, the necessity of transmitting the power electrically to points on the railroads where locations for the establishment of manufacturing plants and transportation facilities are within easy reach.

The location of many of our manufacturing towns has been decided by desirable and ample water-powers, or the abundance and cheapness of fuel without regard to nearness of raw materials, or the markets for the finished product. Therefore, as the item of cost of labor lessens by use of improvements in machinery and methods of manufacture, the item of cost of transportation constitutes a larger percentage of the cost of the finished product; hence, the question of conveying the power to the material or conveying both power and material to some advantageous point grows in importance.

Conveyance of power by the older form of belting and shafting was not only extremely local and inefficient but on the inside of buildings was regarded as unsanitary, more costly to operate and occupied too much room. Then, too, this method lost from 40 to 50 per cent of its power, whilst electricity loses only from 10 to 18 per cent in transmission. Electricity transmitted not in excess of forty or fifty miles will cost, regarding all the elements of installing wheels, generators, switchboards, etc., from $16.00 to $40.00 per horse-power, while steam, under similar conditions, is estimated at from $45.00 to $70.00 per horse-power. Electrically transmitted power has undisputed advantage for manufacturing purposes, and it will be a tremendous factor in developing non-utilized water-power, making industrial communities where none exist, and giving wider horizon to cities already feeling the quickened pulse beat of new commercial life.

Were the flow of the rivers constant throughout the year the problem of hydro-electric power would be comparatively easy, but

as changes occur it becomes necessary for us to bear in mind the difference between "ordinary low flow" and "average flow."

Ordinary low flow is intended to represent the average flow during a period of twenty or thirty days in the late summer or fall, when the river is lowest. A record taken for a period over five years shows the month of lowest stage to be September.

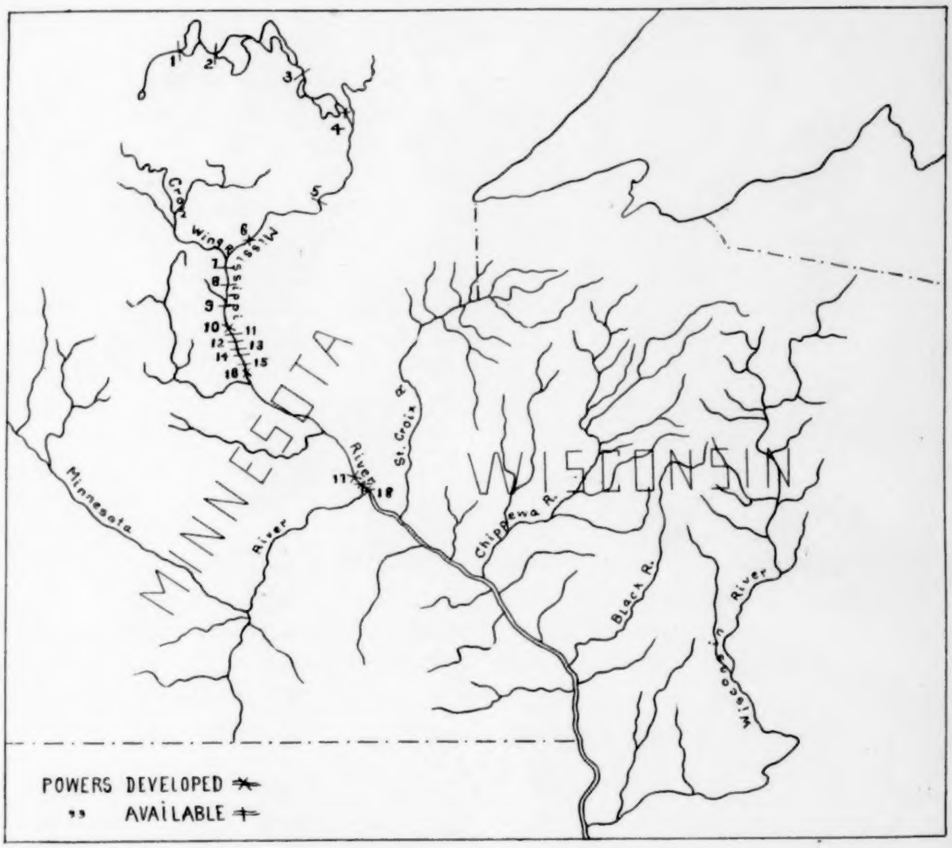
Average flow represents the stage of the river assuming it to remain constant from one day to another all the year through. It is practically the actual condition that would exist if a perfect and uniform system of reservoirs was applied throughout the Mississippi Valley, so that the floods could be held back and distributed during the low-water seasons. This question of average flow is of great importance in considering water powers.

Already, as a result of the transmission of power by electricity, the tendency in the cotton mills of the South is toward building larger and more efficient plants instead of the many small mills using the water powers direct. As in the seaboard region of the South the use of water powers has developed rapidly and established marvelous industrial changes, so we may anticipate similar transformation in the valley of the Mississippi.

The Mississippi River System

The drainage area of the Mississippi is estimated variously from 1,261,000 square miles to 1,390,000 square miles; the length, from mouth to source, if Lake Itasca be regarded as its beginning, is 2,616 miles, while from the mouth to the source of its greatest tributary, the Missouri, it is estimated as 4,200 miles. Its average width is 1,000 feet, but in the lower reaches of the river it varies from one-half to three-quarters of a mile, and at flood season it is far in excess of these latter figures. The maximum depth of the channel in the lower half of the river is from 60 feet to 125 feet at the mouth. The maximum flood level is about fifty-two feet above low water on the lower section, diminishing to fifteen feet at the mouth. The source of the Mississippi is 1,680 feet above sea level. The average total discharge from the basin is 675,000 cubic feet per second.

The major axis of the basin is 1,700 miles long, extending southeast from the northwest portion of Montana, through the Dakotas, Nebraska, Missouri, and Tennessee, down



1. Benidji.	6. Brainerd	11. Pike's Rapids.	16. Sauk Rapids.
2. Cass Lake.	7. Olmsted's Bar.	12. Cashe's Rips.	17. Minneapolis.
3. Pokegama Falls.	8. Conradi's Shoals	13. McDougal's Rips.	18. St. Paul.
4. Grand Rapids.	9. Elk Rapids.	14. Blanchard's Rips.	
5. Big Eddy Rapids.	10. Little Falls.	15. Watab Rapids	

into the northwest corner of the State of Alabama, with one arm going off northeast into the Allegheny Mountains. The basin takes in practically thirty states and a part of the Dominion of Canada. With regard to areas drained and the actual volume of the streams the basin may be divided into four grand divisions: The Missouri basin, the basin of the Arkansas and Red rivers, the Ohio basin, and the basin of the upper Mississippi.

From the west toward the east the land slopes south and east from an elevation of 4,000 to 6,000 feet at the base of the mountains, diminishing to less than 1,000 feet at the Mississippi. In the eastern section, a large portion is but slightly elevated. In eastern Kentucky and Tennessee occur the Cumberland plateau and other tablelands. The average elevation is from 500 feet, in southern Illinois and Indiana, to 800 feet in the northern portions of these states. The average elevation of Ohio is about 1,000 feet. In Kentucky and Tennessee the surface varies from 300 feet, near the Mississippi, to from 600 to 1,000 feet in the central portions. On the Cumberland plateau the height averages 3,000 feet, and in the East Tennessee Valley from 600 feet to 2,000 feet. The average elevation in the immediate region of the sources is from 1,200 to 1,600 feet in Minnesota and Wisconsin. The lay of the land is particularly well adapted to the development of water powers in the upper regions of the rivers of the Mississippi system. There are not a few conspicuous places where tremendous power can and is being developed. There are many lesser sites which, when taken together, make an astounding aggregate.

Available Power on Upper Mississippi

From Lake Itasca to Lake Bemidji there is an average fall of nine feet to the mile, the power under a head of ten feet at an ordinary low stage above Lake Bemidji is estimated at eighty-seven theoretical horse-power, enough to run a good-sized custom mill. Below this point is to be found another site between Lake Bemidji and Cass Lake, where 220 to 475 horse-power could be developed. Two other powers of sufficient importance to command notice are found in the next stretch of 326 miles, namely, at Pokegama Falls and Grand Rapids.

At Pokegama Falls the development of from 1,170 theoretical horse-power to 2,477 theoretical horse-power is possible, which,

with increased height of dam could be increased ultimately to 5,200 horse-power. This power is usable for most of the year. At Grand Rapids a dam of six feet could be built, which would not interfere with Pokegama Falls, and develop, under varying conditions, from 700 to 1,500 theoretical horse-power.

From Grand Rapids to Little Falls, a distance of 220 miles, there is no concentrated descent which could be rendered available. Immediately above Little Falls there are several rapids which, under improved conditions, would render appreciable quantities of power. At Big Eddy Rapids it would be possible to develop from 2,200 to 5,000 theoretical horse-power, depending upon the flow. Just four miles above Brainerd, on the Northern Pacific Railroad, is another vantage point where a drop of some four and a half feet is found in a distance of 4,100 feet; the stage of the river under similar conditions is slightly greater than at Big Eddy Rapids, so that practically an equivalent of power might be produced.

At Olmsted's Bar, about eleven and one-half miles below the junction of Crow Wing River with the Mississippi, is the possibility of from 3,780 to 8,630 horse-power. Conradi's Shoals and Elk Rapids, between Olmsted's Bar and Little Falls, afford opportunity for the production of several thousand horse-power, it being suggested that the aggregate would exceed that at Olmsted's Bar, or in excess of 8,000 theoretical horse-power. At Little Falls, 106 miles above Minneapolis by water and ninety miles by rail, the river has a descent of 7.3 feet in 2,100 feet. The configuration of the local surroundings is such that at the bottom of the falls the banks on either side of the stream range from twenty feet to twenty-seven feet above the surface of the water.

A number of years ago several mills were operated at this location, but those in charge chose rather poor sites, letting the excellent place at the crest of the falls go by default. The stream here has been pronounced navigable, and the consent of the government would be necessary before a dam could be built, but this could be easily arranged by providing sluicing for logs and perhaps a lock for steamboats and barges. With a dam of ten feet 3,951 theoretical horse-power would be obtained under ordinary low flow, and with average flow 8,696 theoretical horse-power. By raising the dam to sixteen feet and concentrating effort at this point, power to the extent of 14,500 horse-power could be developed, but it

might impair Elk Rapids above, which would produce in the neighborhood of 3,000 horse-power. The difference would be such, however, as to favor Little Falls.

From Little Falls to Sauk Rapids, thirty-one miles distant, the descent of the river is rapid, the average slope being 3.1 feet per mile. The chief points of concentration are Pike Rapids, Cashe's Rips, McDougal's Rips, Blanchard's Rips and Watab Rapids. It has been proposed to build dams, one at Cashe's Island, with a head of thirteen feet, and another at Blanchard's Rips, with a head of ten feet. The first would probably flood back to Pike Rapids and the second to about the foot of Cashe's Rips. The flow being essentially the same here as at Little Falls, the ordinary low flow would produce, under three feet head, 5,136 theoretical horse-power, and under ten feet, 3,951 theoretical horse-power; with the average flow the result would be respectively 11,660 horse-power and 8,696 horse-power. The total fall from the head of Little Falls to Sauk Rapids is ninety-five feet, and there are several places, according to James L. Greenleaf, Assistant Professor in the School of Mines, Columbia University, New York, where utilization of power could be made at little cost.

In the stream between St. Paul and the headwaters dams now exist at the following places: One between St. Paul and Minneapolis, two at Minneapolis, one at Watab Rapids, one at Little Falls, one at Brainerd, one at Grand Rapids. And Congress has authorized in addition; one between St. Paul and Minneapolis, one at Ostego, one at Monticello, one at St. Augusta, two at Sauk Rapids, one at Pike Rapids, one at Bemidji. Also one on the Crow Wing River below Gull Lake.

The influence of the reservoirs at the headwaters on the water powers and what they mean to the states interested cannot be adequately treated here, but they must be considered briefly. Their prime purpose is in steadying river discharge to prevent abnormal flow, or at least minimize the occurrence and to furnish ample flow in the dry season. The five reservoirs established by the United States in Minnesota between the years of 1884 and 1895 have, during the period of their operation, been of inestimable value. They have cost a million and a quarter of dollars to build and maintain. They store ninety-six million cubic feet of water. From an estimate recently made the manufacturing of Minnesota

is benefited to the extent of $13,000 for each billion cubic feet of water so stored. The influence, therefore, of those existing and of the balance of the original number projected, forty-one, which ought to be made operative, is tremendous, and affects the whole question of water powers on the Mississippi proper.

The Mississippi River above St. Paul, as shown, is exceedingly well adapted to water-power purposes. The banks are generally high, making flowage rights comparatively inexpensive; the bed is generally firm, making foundations comparatively easy; the slope of the river is exceptionally steep, making mill sites numerous; the total fall from Grand Rapids to St. Paul is about 578 feet, and a reservoir system at the headwaters of the river greatly increases its low-water flow.

At Minneapolis the river has a utilized head and fall of sixty-eight feet, which is divided into two parts. At the upper falls are located all the flouring mills and other industrial establishments; at the lower falls is the electric plant. The utilized power, in 1906, at St. Anthony Falls was 40,000 horse-power, while plans under consideration will increase this from three nearby sources by several thousand horse-power. At Keokuk, Iowa, plans are under way, by the Hamilton Power Company, to develop an immense power plant which will create 200,000 horse-power. Few available sites exist below this point, on the Mississippi proper, but numerous and valuable water powers exist on the two great branches tributary to the Mississippi, on the Missouri and the Ohio and its branches.

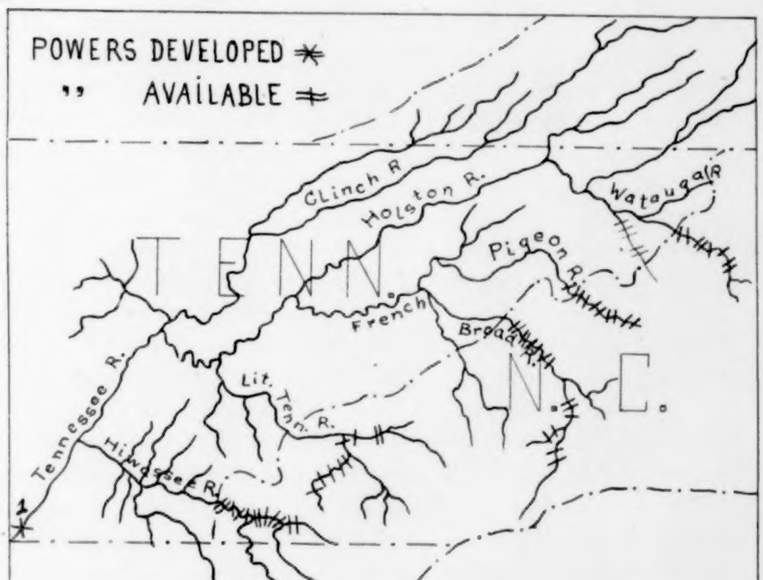
Power on the Missouri and Tributaries

Difficulty in getting accurate and complete data for the Missouri exists, because few of the states adjacent to its course have done anything along this line. However, much valuable information is at hand from the State of Montana which shows what the Missouri may furnish in the future.

In 1898 the Madison River Power Company began the construction of a plant which was completed in 1902. It is located on the Madison River Canyon, near Red Bluff, sixty-five miles from Butte, to which latter place the current is brought for commercial use. The transmission is by aluminum wire with from 40,000 to 80,000 volts. The cost was approximately $300,000.

The Big Hole Electric Power Company is located on the Big

1. Red Bluff.
2. Canyon Ferry.
3. Great Falls.
4. Kalispell.



1. Chattanooga.

Hole River, twenty-seven miles from Butte, on the Oregon Short Line Railway. The dam is fifty feet high and about 500 feet long on the crest. Four thousand horse-power is developed and sent to Butte across country at 15,000 volts. This plant was started in 1897 and completed in 1900, the cost being estimated at $800,000. In the northwestern end of the State of Montana another successful power company is in operation. Near Kalispell, on the Big Fork River, is the plant of the Big Fork Electric Power Company. Here the fall from the surface of the water in the receiving basin to the base of the wheel pit is 109 feet. A capacity of 1,350 horse-power is developed, the plant having cost $150,000. The demand for the power from this plant has been such as to compel the company to take steps to increase its output.

The Missouri River Power Company has its present power house located on the Missouri River about twenty miles almost directly east of Helena, at the little town of Canyon Ferry. At the mouth of the canyon a dam 480 feet in length has been thrown across the stream, designed to give a thirty-foot head of water. One of the peculiarities of this special body of water is, that though the water may freeze in a lake a short distance back from the canyon, the water flows to the power house as free from ice in winter as in summer. Here is developed 10,000 horse-power, all of which is consumed, and the demand is greatly in excess of the supply. Helena, twenty miles away and East Helena fourteen miles away, receive their supply from this point, and recently power has been transmitted to Butte, sixty-five miles away. This plant is distinctive in that it transmits power successfully at the high pressure of 50,000 volts.

Last year Congress granted to another company, the Missouri River Improvement Company, the right to build a dam below the Great Falls of the Missouri, and about fourteen miles down the river from the City of Great Falls. What power will be developed here is yet a matter of conjecture, but it bids fair to eclipse the largest yet developed in Montana. Little information exists as to present available sites, but a glance at the region will indicate that the resources have just been touched. At Sioux Falls and other points along the Missouri and its tributaries various projects have been broached. As we come down out of the foothills the even trend of the prairie precludes water-power in the lower reaches of the river.

The Ohio and Tributaries

By the union of the Monongahela and Allegheny rivers at Pittsburg the Ohio River is formed, with a drainage area above that point between 18,000 and 19,000 square miles. Its drainage basin totals 214,000 square miles.

The principal streams contributing to this area are: on the north side, the Beaver, Muskingum, Scioto, Great Miami and Wabash rivers, and on the south, the Little Kanawha, Great Kanawha, Big Sandy, Licking, Kentucky, Green, Cumberland and Tennessee. These streams give to the Ohio system a vast range of territory and make it tributary to the larger part of the western Appalachians, all the way from New York down into Georgia and Alabama.

Mr. Dwight Porter states in the seventeenth volume of the census report of 1880 that there is "no question that, in their upper courses, above the limits of navigation, the various tributaries on the south side of the Ohio and their own affluents, present in the aggregate much available water-power. Those to the north of the Ohio are already largely in use, and will admit of much further development." It was originally thought that the powers in this region were individually of no great magnitude and suited, therefore, only to small manufacturing, but when we see 50,000 to 60,000 horse-power plants going up on the stream hitherto regarded as of little consequence we are compelled to revise authorities of twenty years' standing.

One of the chief disadvantages to-day to the fuller utilization of the streams, especially on the north side of the Ohio, is the insufficient supply of water in summer and fall, and the heavy freshets; by engineering skill these objections are being met, and the policy of afforestation will also aid. The principal use of power on these rivers to date has been for flouring, grist and saw mills, but on certain rivers, notably the Great Miami and the Beaver, general manufacturing has established itself.

The Ohio River *per se* presents few opportunities for the development of water-power, the two really available sites being at Louisville and Davis Island Dam. Engineers estimate that from 17,000 to 144,000 horse-power can be produced at Louisville Falls, 600 miles below Pittsburg and 135 miles below Cincinnati. As early as 1873 plans to this end were presented utilizing

1. Davis Island Dam.
2. Connellsville.
3. Falls City
4. Beaver Falls.
5. New Brighton,
6. Fallston.
7. Zanesville.
8. Marietta.

the present government dam and canal. On the Indiana bank of the river a low wing dam of rip-rap diverts enough water to run a few small plants situated above on the bluffs, and a trifling use of power is reported also on the Kentucky side. Many objections have been raised, but the main project is entirely possible if sufficient capital would develop the site.

At Davis Island Dam, a few miles below Pittsburg, it is suggested that from 3,000 to 4,000 horse-power could be developed on an average of from seven to eight months a year, by taking advantage of the ten-foot fall below the dam as now constructed. The two outer branches of the Ohio, viz., the Allegheny and Monongahela-Youghiogheny furnish, comparatively, little power. On the Allegheny there are a few powers, ranging from 75 to 250 horse-power and one of 570 horse-power. With the improvements now being made in the generation of hydro-electric power, however, these conditions may be improved. The Monongahela is essentially a navigable river all the time, the aim of the coal companies being to get their barges down to Pittsburg, thence on to the West and South. There are a few powers, none in excess of seventy horse-power, however.

Water powers are utilized to a greater extent on the Youghiogheny River, there being two points at which use is made of electric power.

Connellsville, in the center of the great coke region of Pennsylvania, develops from 70 to 170 horse-power; while fifty-six miles from the source, at Falls City, where a thirty-four foot fall is found, from 350 to 900 horse-power is used. On the Beaver River, at Beaver Falls, there is developed, under a head of nineteen feet, from 650 to 1,510 horse-power. At New Brighton and Fallston, on the same river, from 600 to 1,400 theoretical horse-power is produced.

The Muskingum River, taking in the greater part of eastern Ohio, has eleven state dams constructed from which power is leased for thirty years at a time for so much per cubic foot per second per annum. On this stream the two more important points are Zanesville, 966 horse-power, and Marietta, where 900 horse-power is developed. The Little Kanawha furnishes small sites developing from 12 to 215 horse-power with an average of 35 horse-power. On the Great Miami water powers have been util-

ized for years, the estimated power now being developed in the valley is placed at from 8,000 to 9,000 horse-power.

The Upper Tennessee

To the south the Tennessee River furnishes tremendous possibilities. Rising in the foothills of the Blue Ridge Mountains and cutting through the Appalachian system by many tributary streams, the story of the Tennessee is the account of its tributaries to a large extent. Above the Tennessee line the drainage basin is about 1,831 square miles. From Georgia into North Carolina the stream is rather sluggish, but from beyond Franklin, North Carolina, it goes through rocky gorges with a descent of from ten to forty feet to the mile. A few water powers are in use here, but the possibilities are enormous. One of the principal tributaries of the Tennessee, the French Broad River with its many affluents, furnishes admirable sites in its passage through the Smoky Mountains and the smaller ranges to the westward.

Through the upper counties, near its origin in North Carolina, the river passes through a deep narrow gorge, from which power developed could be carried back into a rather rich country. Below this section are numerous falls where, according to the report of the state geologist, "water powers of great magnitude" can be developed. Lack of data as to flow of the stream prevents expressing this condition in figures of measurable value.

The Watauga River, another tributary to the Tennessee, is described as being everywhere a rapid one, for the most part running through a deep narrow gorge with rock bottom and rock sides, thus furnishing at many points excellent facilities for the construction of dams. The fall of the stream from the Tennessee line, a distance of some nineteen miles, is 900 feet, the average fall per mile being about forty-seven feet, hence the matter of utilization becomes merely a matter of convenience.

All told, there are about ten available first-class water-power sites on the thirty miles of the stream. At the mouth of Beech Creek, about four miles above the state line, there is an especially fine site where, from the report of the geological survey for North Carolina, it is said almost any desired power can be generated. Thousands of horse-power are unutilized on the comparatively small reach of this powerful stream.

The Toe River furnishes another admirable source of power. This stream, some forty-five miles in length, offers nine available water-power sites, and a projected and partially completed rail, road follows the river sufficiently near to make the latent water powers accessible. Gaugings taken show that the flow is of such a nature as to develop from sixty-six to ninety horse-power per foot of fall throughout the region where the available sites exist. The South Toe furnishes seven available sites, one of which has a fall of 3.5 feet in 100 feet, over a ledge of coarse granite, at which point the stream is fifty feet wide and where ample space exists for buildings. Another branch, the Caney River, gives eight sites for power usage, and the character of the stream, flowing through a deep narrow rock-bound gorge, makes dam building easy.

The Pigeon River, some fifty-five miles in extent, joining finally with the French Broad, through the major part of its course has a fall of twenty-six feet to the mile. It furnishes four excellent sites and the surrounding country is such that by transmission it would furnish power to towns on the Western North Carolina Railroad, and to one or two other larger towns, notably Waynesville. Numerous other powers are found on the Hiwassee, where thirteen are available; the Cheowah with seven; the Tuckaseegee with seventeen; the Little Tennessee with nine, and the New River with fifteen.

One of the most remarkable evidences of the growth of hydro-electric development is to be found in the recent project for the building of a plant at Chattanooga, Tennessee, which will develop 52,000 horse-power.

All through this region evidences of the increased use of this resource is to be seen. The Cumberland River in the upper reaches above Nashville furnishes several ample sites for power which, if developed, would, by transmission to Nashville and other river points, aid in swelling the $10,000,000 worth of trade which is annually carried on this stream.

Enough has been detailed to demonstrate the mighty force now unused in the great valley of the Mississippi. The maps show that the powers are concentrated in four general centers, each of which has its significance. In the Missouri or Montana district the power to-day is being used to light cities, operate urban railway lines, run copper smelters, for local manufacturing and for mining. As

a factor in city life and growth it is of the greatest importance. Comparatively cheap power will furnish a stimulus to the production and manufacture of the minerals mined, give cheaper and more frequent transportation facilities, allow of the growth of cities and provide a basis for new communities.

Capitalized at $16.00 per horse-power per annum it is conservatively estimated that from $64,000,000 to $70,000,000 worth of hydro-electric power is annually going to waste in the Mississippi system.

The rise of Minneapolis as a milling center has been largely due to her natural site where she enjoys an unusual power advantage. The present total valuation of water-power developments in operation on the Mississippi River between Minneapolis and the reservoirs, including mills, factories, electric-light plants and other industrial establishments depending upon water-power can safely be estimated at $2,250,000. There are now building and in process of construction water-power developments above Minneapolis to the value of $1,000,000. Five large power plants are under consideration at the estimated value of nearly $3,000,000.

In the region of the twin cities of Minneapolis and St. Paul the annual value of flour out-put from mills using water-power is $58,300,000, feed $6,700,000, woolen goods manufacture $500,000, electric light and power $800,000, with sundry other products totaling some $67,000,000. The aggregate value of flour mills, factories, woolen mills, elevators, shops, etc., reaches the neighborhood of $18,000,000, with the approximate annual pay-roll of $3,500,000.

The increased use of our natural resources in this section will mean our greater ability to compete with the foreign flouring and milling industries, enable us to develop to a greater extent our agricultural regions, to increase our manufactured products and enable a larger population to live in the region tributary to the upper Mississippi.

As copper and general mining will be benefited in the northwest, flour and general manufactures in the Minneapolis region, so coal, pottery, iron and steel, cutlery and general manufactures would be benefited in the Ohio River region. It is claimed that much of the manufacturing supremacy of eastern Ohio has been due to her cheap water-power. In the southeastern part of the

system on the west-Appalachian region there is immense possibility, but as yet there has been little development.

Chattanooga, Tennessee, has a bright prospect with the development of the proposed 52,000 horse-power dam—this is going to mean much to the agricultural implement business and cotton manufacturing throughout the South. The lumber and cotton industries will have a tremendous impetus given them, while better lighted cities and better transportation facilities will give a new horizon to the people. Cheap power, and long-distance transmission with its increased output under more desirable conditions than at present, concentration of production, better civic conditions, in what are now practically isolated rural communities will come as the consequence of our fuller appreciation of this valuable but inadequately utilized resource.

THE IMPROVEMENT OF THE MISSOURI RIVER AND ITS USEFULNESS AS A TRAFFIC ROUTE

By Lawrence M. Jones,
President Missouri Valley River Improvement Association, Kansas City, Mo.

By all fair reasoning the Missouri is the greatest river on the American continent. From the three forks of the Missouri northwest of Yellowstone Park to its mouth, as the stream meanders, is a distance of 2,547 miles, and to the Gulf of Mexico, the Missouri-Mississippi has a length of 3,823 miles. The Missouri is longer than the entire Mississippi, and more than twice as long as that part of the Mississippi above their confluence. The Missouri drains a watershed of 580,000 square miles, or one-sixth of the land surface of the United States, and its mean total annual discharge is estimated to be twenty cubic miles, or at a rate of 94,000 cubic feet per second, which is more than twice the water discharged by the upper Mississippi. The Missouri is by far the bolder, the more rapid and more turbulent of the two streams.

It is the most feasible waterway project in the United States to-day. The results to be realized by its improvement are more far-reaching for the amount of money to be expended than can be secured from any other project. The Missouri has the greatest navigable length of any river in the United States; it has a greater and more continuous volume of water than any other river in the United States; it has more and better stretches of "good river" than any other. It is the only interior river having water enough of its own to sustain a minimum channel of twelve feet.

With a twelve-foot channel the Missouri would have a freight-carrying capacity equal to 600 single-track railroads, and yet the improvement would cost less than to build one single-track railroad from Kansas City to St. Louis. A competent authority has calculated that with a twelve-foot channel, the Missouri would save the West every year an amount that would more than equal the entire cost of improvement from its mouth to Kansas City. Its improvement as planned would solve two great problems for the West: high and unfair rates and inability of the railroads to handle

the traffic on the present tracks. The greatest problem in railroad transportation to-day, aside from that of exorbitant and unequal freight rates, is to secure tracks upon which to move cars. New tracks to relieve the congestion cannot be built. There is neither money, material, nor men for the work. When we realize this, then we can see the urgent necessity for improving the great natural highways of commerce flowing past our doors.

The History of Steamboating on the Missouri

When the steamboat and the prairie schooner were the only means of transportation to the promised land of the great West; when the gold hunter, the trapper and the adventurer were the pioneers of civilization, hundreds of boats plied the waters of the Missouri, going as far north as Fort Benton, twenty-five hundred miles from St. Louis. Fortunes were made by a boat in a single trip. Steamboating reached the summit of its prosperity about the time of the breaking out of the Civil War. More than 700 boats navigated the Missouri in those days, and more than 200 now lie buried in the sands between Kansas City and St. Louis—silent reminders of the glory of other days.

The first steamboat—the Independence—ascended the Missouri River as far as the mouth of the Chariton River in the spring of 1819. However, there were few steamboats on the river previous to 1840, owing to the limited demands of commerce. For many years the navigation of the Missouri River was confined to primitive wooden craft, and its commerce was restricted to the fur trade; but as soon as it was known that the Missouri was such a navigable river, and that it flowed through such a rich agricultural region, the navigation on the river increased until the year 1858, when it reached its maximum.

In 1858 packet lines were established from the mouth of the Missouri to Miami, Kansas City, St. Joseph, Omaha and even to Sioux City. Those lines carried United States mail and express freight. So numerous were the boats on the river during this period that it was no unusual sight to see five or six lying at the landing at the same time, and at no time was a boat out of sight during the boating season, which continued from March to November. The prosperity that this great traffic brought to the river towns was phenomenal and the population of many of them was

larger fifty years ago than to-day. In 1857, fifty years ago, the wharfmaster at Kansas City reported more than 700 steamboats at the Kansas City Levee. The levee, then and for many years, was the busiest part of the business district, but the Civil War, following close upon this great prosperity of the Missouri River caused the loss of many of the boats and drove others from the river.

In 1862 gold was discovered in Montana, in consequence of which there was a great rush to that country. The Missouri River was the only means of transportation and of course this caused a wonderful revival of steamboating. This was of but short duration, but it proved to be exceedingly profitable, as the rates demanded and paid were exorbitant. The voyage to Fort Benton was 2,200 miles and this was beset with danger, both in the navigation and from the Indians. The usual rate charged on freight was from ten to fifteen cents per pound and a first-class passage to Fort Benton cost $300.00. The railroads which were then rapidly expanding and pushing into the new territory soon came into such competition with the steamboats that they forced them out of business, by carrying freight cheaper than the steamboats did. However, as commerce began to leave the river, railroad rates began to advance, until Kansas City business men felt the necessity of seeking relief by restoring river competition.

In February, 1890, a company was incorporated under the laws of the State of Missouri, with an authorized paid-up capital of $132,500. This company was known as the Kansas City and Missouri River Transportation Company. They built four wooden boats and operated them more or less regularly for four years. Much has been said about the failure of this packet line, but, as a matter of fact, it did more to regulate freight rates between the Mississippi and the Missouri than anything else that had been done before or since. It saved the shipper $100 for every $5.00 he had in it; it established the fact that water competition existed in Kansas City and the railroads had to meet it. The old packet line of 1890 was not a failure; it was a grand success, and Kansas City made millions of dollars out of it. The railroads started in deliberately to put this packet line out of business, and by rebates and other unfair methods succeeded in doing so. In fact, the whole fabric of rates went to pieces, and as the Kansas City and Missouri

River Transportation Company was not properly supported by the merchants, it was forced to quit business. From the time the Kansas City and Missouri River Transportation Company discontinued business until late in the summer of 1906, there were no efforts made to navigate the Missouri River.

The Missouri River Valley Improvement Association was formed July 30, 1906, at a meeting held in Kansas City, attended by representatives of the principal commercial bodies of Kansas City, Missouri, and Kansas City, Kansas. The records of the first year's work speaks for itelf. Its purposes were:

To prove the Missouri River navigable.

To have the river navigated by commercial freight carriers.

To secure from Congress appropriation for improvement of the channel in aid of navigation.

To establish and maintain a close working relationship with the National Rivers and Harbors Congress and other organizations promoting river improvement.

To conduct a campaign of education intended to inform the people of the Missouri Valley and trans-Missouri region, the officials in Washington and the Congress of the United States, of the magnificent possibilities and tremendous commercial importance of Missouri River improvement.

The doubt as to the navigability of the Missouri River by steamboats carrying sufficient freight to render operation profitable which existed when this association began its work, has been entirely removed. The impression seemed to have become general, even in commercial centers of the Missouri Valley, among the officials in Washington and with the members of the Rivers and Harbors Committee, that the Missouri River had passed its days of usefulness as a commercial highway. There is a different impression now.

There are signs of a great awakening of interest in the navigation of the Missouri River and why should there not be, when Kansas City is paying to-day as high freight rates as she did thirty years ago? There is no relief under the law, and the only redress from the grasp of this relentless power, is that furnished by this great highway of commerce, the Missouri River.

Re-establishment of Regular Navigation

One year ago Kansas City decided to begin navigating the Missouri. She did not bombard Congress for an appropriation for the river, but went to work to demonstrate that the thing was feasible. If it was not feasible, we did not want any money from the government; if it was feasible, we were satisfied that, when we had demonstrated that fact, the government would do its part, and we have not been disappointed in our calculations. We believed that, with the use of the river would come governmental co-operation and that we should first show our faith by our works before asking the government for any expenditure of money. We are firmly convinced that use and improvement should go hand in hand. Here was a great river flowing past our doors. Here was the solution of our transportation troubles. In this river dwelt the power that was to free the young metropolis and the great West. The river was the same river as when hundreds of craft plowed its waters. Why not use it now?

One year ago Kansas City procured boats for experimental trips from St. Louis to Kansas City. The experiments were successful. The boats made the trip from St. Louis to Kansas City loaded with freight, without ever turning a wheel backward, and this year regular freight and passenger service has been inaugurated. The successful experiments in navigating the Missouri in the summer and fall of 1906 and the promise of Kansas City to use the river more extensively than ever, enabled our member of Congress, Hon. E. C. Ellis, to get an ample appropriation of funds to start the snag boats to remove obstructions and to have shore lights placed. Two boats, the "General Suter" and the "James B. McPherson," are now industriously engaged in cleaning the channel of snags and other obstructions accumulated during years of governmental neglect. This appropriation was the first that has been made in aid of the navigation of the Missouri for several years. Thus the Missouri was restored "to the map" of navigable streams, entitled to federal aid. In addition to this appropriation, provision was made for a report by engineers, upon which report appropriations may be based for the improvement of the Missouri River in the future.

The next step taken was the organization of the Kansas City Transportation and Steamship Company, the purpose of which

organization was to maintain regular steamboat service between Kansas City and St. Louis. This company put into operation, with the opening of navigation this spring, a line of boats which have made regular trips between Kansas City and St. Louis. The people are now awake to the great things in store for the West through the resumption of navigation on the Missouri. It promises to usher in an era of large development.

With imperfect equipment, we are able to carry freight between St. Louis and Kansas City at an average reduction of one-third from railroad rates. When we get our splendid non-sinkable steel boats, for which we are now letting contracts, we confidently believe we can carry freight for one-half the railroad rates and realize good returns on the investment. We have demonstrated in one year that we have a river, that we have the money to build boats, and that we have the freight for the boats to carry. The old Missouri is once more ready to fulfil its destiny as one of the great commercial highways of the West.

Advantages to Accrue from Improvement of the Missouri River

The best way to arouse sentiment in favor of an improvement is to show the benefits sure to accrue from it. For example, by using the proposed twelve-foot channel of the Missouri, the fourteen-foot waterway via the Illinois River and the Chicago Canal, the Great Lakes, and the twelve-foot Erie Canal, at the average freight rates of water routes as compared with rail, one congressional district of the State of Kansas would have received for its 1906 wheat crop over $5,000,000 more than at the prices paid.

It would not have been necessary that one bushel of this wheat should actually move to New York at this rate. The fact that it *could* would make the price for the entire crop, not only of the district but of the state and adjoining states. Wheat is sold on the world's markets, and the price of wheat in Kansas or Nebraska is practically that of Liverpool, less the cost of transportation. Reducing the rate raises the price, regardless of the ultimate disposition or destination of the product.

To bring the illustrations of the gains in this district a little closer home, it may be said that one county, Sumner, would have gained in 1906 $500,000, or a per capita of $20 for not only the families of the farmers, but for the residents of the cities and towns

as well. Other counties of the same district would have gained per capita from $20 to $40.

It may be difficult to realize just what this would mean to the farmers' families, to the tradesmen of the towns, and to the jobbers and manufacturers of the cities of the whole trans-Mississippi wheat-growing region. It would mean even more because of the lower west-bound freight rates on the products sold to the enriched consumers, adding this large saving to his other big profits. There is to be considered also the enhanced price of other farm products as a result of reduced rates to their best markets. With this also would go a big advance in prices for farm lands, so that the farmer in Kansas to-day may find himself made rich by the improvement of the Missouri River.

The gain in the value of farm lands in the states of Nebraska, Kansas and Oklahoma, accruing from improvement of the Missouri, would pay the cost several times over. The benefits afforded would continue year after year, while the cost of maintenance, once the channel is permanently established, would be insignificant in comparison with either its first cost or its savings to shippers.

Kansas City might have saved several million dollars on its 1906 shipments with an improved channel in the Missouri. This would have been increased largely if the Missouri was used in connection with the Illinois and Erie Canals and the Great Lakes to make a direct waterway to New York, and by the improvement of the Mississippi, to afford a deep water route to the Gulf of Mexico.

The gain to Kansas City, Omaha, and other Missouri River cities would be still further augmented by the great increase of business—in manufacturing, jobbing and other lines—as a result of the low rates and the exceptional prosperity that must come to Nebraska, Kansas, Oklahoma and other Western States by the gain in price of their products.

These two examples—that of the Seventh Kansas Congressional district and that of Kansas City—have been selected from among many, all making the same general showing. What is true of the Kansas counties named is true, in greater or less degree, of the whole State and other Western States as well; and the same can be said of Kansas City and other commercial centers on the Missouri River.

If the producer cannot find means to transport his commodities to a market where they are needed, he is forced to cease or cut down production in his particular line. This means a curtailment of his power to purchase the products of others, which of course has a depressing effect on labor, brings about contraction in financial affairs and recession in business generally. Production is growing five times as fast as railroad mileage, and the railroads of this country are absolutely unable to catch up with the demands of transportation. This will necessitate our reducing our activities in production with the far-reaching effect this would have on labor and capital.

A car shortage would be unheard of if we made proper use of the inland waterways of our country. They would furnish a cheap and reliable means of transportation, not conflicting with the railroads, but assisting them in removing the greatest obstacle to commercial and industrial progress—insufficient transportation facilities. The Missouri River, improved according to the recommendations of governmental engineers, would have a freight-carrying capacity equal to that of 600 railways, fifty times the capacity of all the roads running between the Mississippi River and the lower Missouri and more than twenty-five times the capacity of all the railroads running from the Mississippi to the Missouri at all points.

The economy of operation of transportation lines on the improved Missouri would be such that boats could make large profits in carrying freight at greatly reduced rates between the rivers. Owing to the bend in the Missouri at Kansas City, that city is practically the point farthest west for inland navigation. Accordingly, when the improvement of the Missouri is completed to Kansas City, 390 miles, freight rates will be affected to the entire trans-Missouri Valley.

This territory that pays the same freight rate as Kansas City on traffic moving between the Mississippi and the Missouri constitutes one-fourth of the area of the United States, exclusive of Alaska. One-eighth of the population of the United States lives within its borders. Removed from markets, the people naturally have to pay high freight rates on all they produce and consume. No other section is more in need of or more entitled to the relief that can be furnished only by the improvement of the Missouri River.

These people have no other river project. The rates east of the Mississippi have never been as exorbitant as west. First class, from Chicago to the Mississippi, the rate is 20 cents; Mississippi to Kansas City is 60 cents. At one time the published tariffs from the Mississippi River to Kansas City were on a basis of 30 cents, first class.

The Missouri River constitutes 5 per cent of the entire navigable inland waterways of the United States, including the Great Lakes. It has 14 per cent of the navigable waterway of the region drained by the Mississippi. Its navigable length is greater than the distance by rail from St. Louis to San Francisco. It has a navigable bed above Sioux City of 1,475 miles, or 500 miles more than the entire length of the Ohio. It is the one interior river, except the lower Mississippi, which it feeds, that has a water supply sufficient to make every city along its course for 800 miles a seaport. The territory affected paid, in 1905, 15 per cent of the freight revenue of the United States, or $220,000,000, of which a large part would have been saved to producers and consumers if the Missouri River had been improved.

Cost of Improvement

The cost of improving the Missouri River, from its mouth to Kansas City would be less than that of paralleling the Wabash Railroad, the short line between Kansas City and St. Louis. Government engineers estimate the Missouri River can be given a permanent twelve-foot channel from its mouth to Sioux City at a cost of $40,000,000. The Lakes-to-the-Gulf deep waterway project calls for a fourteen-foot channel, and this minimum depth could easily be obtained in the Missouri below Kansas City with small additional cost. The engineers' estimate of the cost of the work is for $20,000,000 below and $20,000,000 above Kansas City.

The Missouri River is destined to form an important part in the comprehensive system of deep waterways building in the United States. The Erie Canal is being deepened from seven to twelve feet at a cost of $101,000,000 appropriated by the legislature of New York. The Chicago Drainage and Ship Canal has been extended to the valley of the Illinois River, the canalization of which stream would give a fourteen-foot channel from the Great Lakes to the Mississippi. These two waterways, in connection with the

Great Lakes, would open up a water route from the Missouri to New York.

The amount asked for the Missouri is not large in comparison with the cost of improving other streams. The Ohio River, on which many millions have been spent, must have $61,000,000 more to give it a nine-foot channel. The Mississippi needs more money than the Ohio, so that the Missouri is making a modest demand. Draining the granary of the country, with a vast tributary region paying high rates to the railroads, and demanding the relief river navigation would afford, the right of the Missouri cannot be ignored.

Plans of Missouri River Improvement

Two plans for the continuous, systematic improvement of the Missouri River have had official approval—that favored by the Missouri River Commission and that under which work was carried on in the early 90's. The report of the Missouri River commission says:

> In order to obtain a depth of twelve feet at low water, wide enough for navigation, a result that can be regarded as perfectly practicable, suppose it were necessary to spend as much as $50,000 per mile, which recent experiments almost conclusively show to be a liberal estimate, the cost of obtaining this channel, up as far as Kansas City, would be less than $20,000,000. An amount, as before shown, saved to the producers of the valley in one year.
>
> To carry this same improvement to Sioux City would cost only about $40,000,000—saved to the producers in two years.
>
> To improve the river, even between Kansas City and St. Louis, to a low water depth of twelve feet is deemed perfectly practicable, and at a cost per mile of $50,000, not exceeding that of a first-class railroad.

This would give us a highway free to all having a carrying capacity of 600 single track railroads.

Congress made appropriations in 1892 for the systematic improvement of the Missouri River in aid of navigation, but the plan provided for a depth of six instead of twelve feet. Appropriations for this work were discontinued after 1896, and not renewed.

Appropriations for Waterways an Investment, Not an Expense.

It is estimated that the internal trade of the United States aggregates more than twenty-five billions of dollars annually. Appropriations of fifty millions annually for waterways would be but a fraction of one per cent of this great business. As commerce bears the great bulk of the expenses of the government, it seems but fair that a liberal part of governmental appropriations should be directed toward the upbuilding of commerce. In the race for commercial supremacy, we must of necessity equip ourselves with all the facilities necessary to hold our place in the commercial world. If, by the expenditure of fifty millions annually on our waterways, we could save our citizens hundreds of millions in transportation charges, to say nothing of the great impulse it would give to all our industries, it would not be a waste of money, it would not be an expense, but a magnificent *investment.*

There is a close relation between the improvement of our rivers and the building of the Panama Canal. If the United States is to realize what it should from this great undertaking, it is absolutely necessary to improve the waterways of this country. If we do not do so, we are practically building that great canal for the use of foreign nations. The improvement of our internal waterways will enable us to compete with foreign nations for the trade of that great country south of us, where we make such a poor showing to-day. With improved waterways and the Panama Canal, we are in touch with the rich trade of the Orient, the prize of commerce for thousands of years. The last fifty years have been the most wonderful in achievement in the history of the world. Those fifty years cover the life of Kansas City and the great West. The achievement of those brief years is but an earnest of what may be accomplished in the future. The West asks that it may be allowed to use the great resources with which it has been endowed by nature.

COLUMBIA RIVER IMPROVEMENT AND THE PACIFIC NORTHWEST.

By Frederic G. Young,
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A system of transportation, adjusted to the needs of the Pacific Northwest, can hardly be a counterpart of those developed for the older sections of the country on the opposite and less-folded side of the continent. The specific conclusions with regard to the supplementary functions and to other relations of the rail and the water routes found true throughout the East will probably need modification before being applied here. At any rate, the conditions in the Pacific Northwest that have to be taken into account for determining the features of the most economical and efficient system of transportation for this region are so striking and unique as to warrant a brief reference to them.

The highways over which the productions of the Pacific Northwest must be carried to reach the consumer lie on the Pacific in one direction, and stretch across the backbone of the continent in another. These opposite destinations for fairly equal proportions of its grain, lumber, fish, livestock, wool and fruit affect the features of the transportation system adapted to its needs and differentiate this system from that of the Middle West, whose products almost exclusively find their market in the direction of the Atlantic seaboard.

Again, the striking contrasts between the lay of the land in the Columbia basin and that of the basin of the Mississippi must, in the nature of things, exhibit themselves in contrasting systems of transportation when these have become fully adapted to their respective conditions. On the imperceptibly sloping, almost unbroken and but gently undulating, plains of the Mississippi and the Missouri the problem of providing economic means for carrying the commodities of commerce is quite different from that presented by a region largely composed of table lands, here and there furrowed by deep valleys with precipitous slopes, and bordered by

high ranges of mountains stretched directly across the path of the routes leading out to the markets of the world.

The lines of least resistance for traffic are more pronounced in the Columbia basin than in any portion of the East. The uniform meshes of the railway net-work of the Mississippi Valley will hardly be realized here and for other reasons than a lack of uniform productivity throughout all portions of this basin. The longer way around will, in this region, more frequently be found the more economic route to the market. Until release is found from the pull of gravity so that the lifts and drops in passing over intervening ridges do not involve heavy costs, the main lines of railway here will thread the main valleys. This means that even in the matter of distance the water routes for heavy traffic will be at but slight disadvantage here as compared with the rail; add to this the fact that the Columbia "seeks the ocean on a line parallel with the trade channels and not at right angles to them," as is the case with the Mississippi in relation to the major portion of the volume of trade of its valley; and the further facts that have repeated endorsement of the engineers of the national government, that the banks of the Columbia "are more stable, its waters more clear, its ice blockades are much less in duration than on the great waterway in the East," and we have something of a basis for the presumption that transportation on inland waterways in the Pacific Northwest is destined permanently to assume a comparatively larger importance than in any other section of the country, and that the improvement of these waterways so as to realize their largest utility is a matter of more vital interest to its people than to those of any other section. In all this we have grounds for a tentative hypothesis at least that the ensemble of conditions in the Pacific Northwest are unusually favorable for reliance upon waterways as routes for heavier traffic and unusually obstructive to the development of a net-work of air-line rail routes with easy gradients.

Before developing this hypothesis, through reference to the experience of the Pacific Northwest, while securing so much of a system as it has, attention should be called to one other aspect of the situation here. The Pacific Northwest is conspicuously a gateway for the commerce between the main body of the American people in the eastern portions of the country and the Orient.

Three factors conspire to bring this about. It is on the line of the great-circle route to the East, it has the only sea-level passageway through the Cascade-Sierra barrier on the western edge of the continent, and it possesses the matchless harbors of Puget Sound. The transcontinental lines penetrating to this region were located, built, and have ever since been operated, with their gateway interests dominant. Even to-day the greater construction activities and expenditures for the Hill and the Harriman roads—a Hill road paralleling the Harriman line down the Columbia to Portland, and a Harriman road paralleling the Hill line from Portland to Seattle—show that the interests of the producer of this region are neglected and even sacrificed in the rivalry for the gateway traffic. The local producer has received some consideration at times from these transcontinental railway magnates. A meager provision of "feeders" exists. Some have built more than others, but with all and always competition in the transcontinental service has been the main concern.

As a matter of fact no independent lines for the service of the producer of the Pacific Northwest exist. While the Oregon Railway and Navigation lines and, in a less degree, the Oregon and California line, were originally planned for local service they soon, through lease and purchase, became mere links in transcontinental systems. There is thus in a large sense no system of rail transportation for the Pacific Northwest. As it is, the people of this section get the crumbs of service and have laid on their shoulders through high charges the great burden of the support of the systems as carriers of transcontinental traffic.

This situation would make the plight of the producer of the Pacific Northwest extreme were it not for his advantages in the wonderful natural resources at his command. Suppose the haul across the Rockies is a natural one for part of even his bulky grain and lumber. Yet the carrying capacity of these roads is so helplessly over-taxed that they are under the necessity of rejecting consignments, indirectly by exorbitant charges and directly by refusing to furnish cars, as is witnessed at the present time in the embargo on the lumber export business to the Middle West. Increased equipment and double-tracking are out of the question under existing financial conditions. Should the managing agencies of these railway systems redeem themselves in the eyes of the

people and win confidence so that with funds at their command they could bring the carrying powers of their roads up to the demands made upon them, still the producer of this region would still be at the mercy of those who have pretty consistently ignored him except as he might obtain relief through the mediation of the Interstate Commerce Commission or, more effectively, through independent means for getting his productions down to the sea.

The release of the producing energies of this region from the vise-like grip in which they are held by the systems of rail transportation as at present developed would be fully achieved if a system of inland waterways for traffic needs could be made available. On these the annual output of products could, free from the taxing power of monopolies, be floated down to the ocean-shipping ports. The rates of carriage on such waterways would regulate not only the charges on the rail routes parallel to them but also the rates on the transcontinental carriage to the East. There is no question as to the need of them here. In no other section are present transportation facilities so inadequate to existing demands. Car famines recur regularly and in most aggravated forms. No other section is taxed so heavily for what service it gets. Nowhere else is potential development being retarded to the same degree.

The problem of progress for this section narrows down to about this: Is it feasible to utilize fully through improvement the Columbia and its tributary waterways to relieve this congestion of traffic and so cheapen transportation costs as to stimulate vastly the development of this section? Before turning to an examination of the availability of the Columbian waterways, just one observation on the results of further delay in undertaking a scientific adjustment of these transportation facilities seems advisable. The present condition of perplexingly inadequate facilities, and monopoly charges prohibitive of further development, naturally raises an unreasoning clamor for duplications in hopes of lower rates through competition. This betrays a state of intelligence that is unmindful of the fact that the cost and maintenance of great railway structures, that serve only to divide traffic with a road already existing, mean fastening upon its supporters a load almost the double of what would have been necessary had the service of the existing line been co-ordinated with that of an

available waterway. Fortunately, however, the measure of undeveloped resources here protects this region, too, from such permanent incubuses much as eastern sections through their development escaped evils of excessive duplications. Surely a clearer conception on the part of the people at large of what is involved in a scientifically adjusted transportation system would have forestalled the possibility of such a transaction as Mr. Harriman's in diverting the thirteen millions from the surplus accumulated through extortionate charges upon the producers in the Oregon Railway and Navigation territory, towards the securing of terminals in Tacoma and Seattle for his line paralleling the road from Portland to Seattle. And certain it is that the people of the Pacific Northwest if they fail to make a careful inquiry into the problem of supplying themselves with an adequate and an economic system of transportation will burden themselves and their posterity with ill-adapted railway duplications and will continue to serve as pawns for the railway magnates in their game for the prizes of transcontinental traffic.

In the general survey of the situation in the Pacific Northwest it was noticed that the lay of the land and the characteristics of the waterways of this region indicated large utilization of them for purposes of commerce. The safest and probably the quickest way to determine what part and how large a part these waterways are adapted to have in a fully adjusted system of transportation for this region is to trace the development of man's experience in using them and the growth of his plans and achievements in improving them. Barring a few formidable obstructions, the major portion of which have already been obviated and all of which are at a reasonable expense susceptible of being permanently obviated, the Columbia River throughout its course approximates more nearly the character of a ship-canal than probably any other river in the world. The Canadian Pacific has run boats on regular schedules on its uppermost stretch, penetrating even to its source, some sixteen hundred miles from its mouth. Much as Henry Hudson on his voyage of discovery sailed up the river that took his name to where Albany now stands, so Lieutenant Broughton, of Vancouver's expedition, profiting through introduction of Captain Gray, pushed the limits of discovery with his vessel to a point near the Cascade Mountains, one hundred miles up stream.

Though the initial cost of obtaining an "open river" throughout the main stream and the important tributaries will be considerable the permanency of such improvements and the smallness of the sums necessary for maintenance more than compensate. Such is the general firmness of its banks (not a little of its course is run between walls of basalt), such is the comparative freedom from the silt that causes erosion and shifting bars, and so short are the periods when it is locked by ice, that its adaptability as a waterway for purposes of commerce may be rated very high.

It was the judgment of John Jacob Astor, or his representative, in establishing Fort Astor, in 1811, near the mouth of the Columbia, that the emporium should be there for commerce with the Orient. A little more than a decade later that judgment was dissented from by the sagacious McLoughlin of the Hudson Bay Company. He moved the entrepôt of trade a hundred miles up the river. His idea, in so far as it affects the use of this lower stretch as an arm of the sea, seems destined to stand. It has not merely the sanction implied in the building up of a city of 200,000 people at the head of navigation on the lower Willamette, twelve miles up from its junction with the Columbia, but also a hearty seconding in the plans and projects of the engineering service directing river and harbor improvements. The consideration that weighed with Dr. McLoughlin in establishing Fort Vancouver near the region whence was obtained his company's wealth of commerce holds good to-day. The ocean liner is brought for its cargo as near as possible to the heart of a large and rich producing country. The improvement, therefore, of the Willamette and Columbia below Portland is virtually of the nature of harbor improvement while that contemplated for the river above and its tributaries is that of inland waterway improvement.

That the waterways of the Columbia basin had eminent natural fitness as avenues of commerce and travel is conclusively proven in the flourishing economic development of this region in the pre-railway era. Up to about 1880, the Columbia River with its tributaries constituted the only trunk lines of inland commerce and travel in the Pacific Northwest. The facilities of transportation afforded by these waterways had sufficed for the upbuilding of a very prosperous community. Some three hundred thousand people were in the valley of the Willamette and along the lower

and upper Columbia. Evidences of a high degree of comfort, of large accumulations and of the great volume of commercial activity elicited remarks of astonishment from visitors to this isolated region that was then still practically without railroads. It is safe to say that no other river system since the era of general railway development served so fully the needs of transportation facilities as did this one of the Pacific Northwest.

But the inland waterways of the Pacific Northwest were like those of the other sections of the country destined to be relegated to a position secondary to that of the railways. Only the one-hundred-and-ten-mile stretch from Portland to the sea suffered no eclipse through being paralleled by a railroad. This section of river channel is, however, in its relation to navigation, to be regarded as an arm of the sea, or harbor passageway, rather than as an inland waterway. The general supersession of the waterway for the railway might seem to be significant of the greater all-around utility of the railway in this section, for it appeared to displace the well-established steamboat completely on certain routes and, for aught that appears on the surface, finally. But it is to be noted that the introduction of the railway into this section was not primarily to furnish facilities of a higher order than those of the existing waterways. They were built here not so much to supersede the unsatisfactory steamboat as they were to earn munificent grants of public domain and to supply the final links in the transcontinental lines giving connection with the East. For passenger and higher class freight service the railroad, here as elsewhere, had, of course, the advantage from the start. The railways along the Willamette and the Columbia won out so decisively, however, from quite extraneous reasons. The falls and formidable rapids in these rivers that made necessary short side canals or portage railways furnish the secret of this easy conquest on the part of the railways. These portage improvements were owned either by private corporations or by the railroads themselves. At the falls of the Willamette, fifteen miles above Portland, a private canal company with its tolls taxed the river traffic nearly out of existence. On the Columbia the owners of the portage railways were also the owners of the railroad paralleling the river. Naturally it was their interest and, from their position of vantage, within their power to block completely the movement of traffic on the river.

Water transportation was not, however, to lapse into a mere tradition in the Columbia basin because of the untoward influence of private monopoly at these portage gateways. Considerable areas of rich and rapidly developing country on the north bank of the Columbia had as yet no railway and kept several lines of boats busy. Another section of country far up the Snake, but magnificently endowed with resources, was not for a long time reached by a railway. It, too, had to rely on a navigable section of that largest tributary of the Columbia for connection with the outside world. The mere idea, too, of a great Columbian waterway had been ardently cherished for more than a century and had too firm a hold in the national consciousness to be completely stifled by the repression of private monopoly. As the dream of Thomas Jefferson it had been back of the leading motive impelling him to urge time and again transcontinental exploration. In his instructions to Meriwether Lewis, when the Lewis and Clark expedition was about to set out, he says: "The object of your mission is to explore the Missouri River, and such principal streams of it, as by its course and communication with the waters of the Pacific Ocean, may offer the most direct and practicable water communication across this continent, for purposes of commerce." The same idea of the larger use of the Columbia as one of the two connecting channels of a transcontinental waterway had been an important feature of the imperial project of John Jacob Astor. And the Hudson Bay Company had actually used it for a generation as its main highway in conducting its widely extended operations in this section. It had, as we have seen, been the sole reliance in their need of transportation facilities of the widely scattered but exceedingly thriving Oregon communities down to about 1880. And though the railways, fortified as they were with monopoly privileges at the portages along the Columbia, and reinforced through the policy of the private canal company at Oregon City, won out against the upper river traffic; on the lower Columbia the ocean export trade was steadily growing with the general community growth induced by the recently completed railway connections with the East.

But whether the commerce on the different sections of the river waxed or waned, certain influences were promoting the inception of projects of improvement. The pressure of the people in this direction and the activities of their representatives in Congress

may always be taken for granted. It is rather the progress of their interests with the engineers of the United States army and the standing the movement was thus getting in administrative circles to which I refer. At the mouth of the Columbia the charts of Admiral Vancouver, of 1792, that of Sir Edward Belcher, of 1839, that of Captain Wilkes, of 1841, the United Coast Survey chart of 1851, and those from periodical surveys thereafter accumulated data from which the problem of widening and deepening the channel across the bar could be solved. The tonnage crossing the bar was increasing year by year. In 1882 the engineers were ready with the details of a project for permanently improving this feature of the river. The value and availability of the waterway from Portland down could never be questioned. Its improvement to navigation by deep-water craft was of utmost importance to the entire Northwest. Not until 1884 was any considerable portion of the produce of this section diverted by the railroads to Puget Sound. The original project for improvement was adopted in 1877.

On the upper river the engineers were making extensive preliminary examinations and reconnaissance surveys while it was still the sole channel of transportation for that rapidly developing "Inland Empire." The exceedingly favorable reports of Major Michler, of 1874, of Major Powell, in 1879, and of Lieutenant Symons, in 1881, gave the demand for an "open river" standing in the inner administration circles. This part of the river was already receiving small appropriations for the removal of minor obstructions in the early seventies. On October 12, 1877, the Secretary of War approved the original plan for canal and locks around the rapids in the Columbia, where it passes through the Cascade Mountain Range. In thus tackling one of the two formidable obstructions to navigation the national government may be said to have committed itself to the securing of a channel available to navigation throughout this system of inland waterways.

The task with which the national government was confronted in having undertaken to secure to the people of the Pacific Northwest the advantage of inland waterways is probably best indicated by pointing out the obstructions that are, or were, encountered in passing from its mouth to its source. From the ocean up to the mouth of the Willamette, about ninety-eight miles, where the origi-

nal depth was from ten to fifteen feet, ocean vessels now pass drawing twenty-five feet of water. The improvement was effected mainly through dredging. From the mouth of the Willamette to the "Cascades," about forty-three miles farther up the river, it is open, and in its natural state has an available depth of eight feet. At the "Cascades" for four and one-half miles it is so contracted in width in passing through mountains that it partakes of the nature of a gorge. In the upper first half mile of this there is a fall of twenty-four feet. Throughout the lower four miles of the gorge the slope is not so steep, but the channel is much obstructed with boulders and reefs. This first great obstruction could be obviated only by a canal and locks. Such works were so far completed as to be opened to navigation in 1896. Proceeding up the river, for forty-five miles, it was again open with a depth of some eight feet. But here most formidable obstructions are encountered—The Dalles and Celilo Falls. In the course of nine miles the river passes over falls and rapids and through contracted channels that completely block navigation. The fall in this distance is eighty-one feet. For some years these obstructions seemed to puzzle the engineers with their magnitude and to appal Congress through the size of the estimated cost of improvement to open navigation around them. Work has barely begun on an approved project for a canal and locks. Proceeding on beyond Celilo Falls we have again a stretch of open river of some 198 miles, with an available depth of four or five feet. The Snake, the largest tributary, which enters the Columbia 110 miles above Celilo Falls, has 146 miles of navigable channel similar in character to that of the main stream. Were we to proceed along that tremendous stretch of river until we came to the international boundary only two more considerable obstructions would be encountered—Priest Rapids and Kettle Falls. These will require canals and locks. Not only are improvements in progress on the two main tributaries above the mouth of the Snake, the Spokane and the Pend Oreille, but the engineers have reported favorably for the removal of the obstructions in about all, if not quite all, of the stretches intervening between those more formidable rapids that will require canals and locks.

Turning back now to the Willamette to note its problems, a complete break in navigation—when the river was in its natural state—was encountered at the falls fifteen miles above Portland.

A private corporation, subsidized by the State of Oregon, constructed a canal around these.

Confronted by problems of the character indicated above the national government has made and, on the recommendations of its engineers, proposes to make improvements at different points of the following nature: With the object of concentrating the river to a moderate width at its mouth and to discharge it as a unit to the sea, thus securing a strong scouring effect with the tidal outflow, the original project, adopted in 1884, provided for a single jetty on the south side of the entrance about four and one-half miles long. This work caused an increase in depth over the bar from twenty to thirty-one feet from 1885 to 1895. But as this desired increase was not permanent, in 1903 a project contemplating an extension of three miles, to the jetty previously constructed, was adopted. A continuing appropriation for the completion of this work has been made. The depth desired is forty feet. The work from the beginning of the original project to the completion of the present extension will cost about $4,500,000. The two projects were based on the same conception of the nature of the problem and the earlier work is fullv utilized in the more extended later project.

The project under which the improvement of the Columbia and lower Willamette is proceeding was adopted in 1902. It proposes a twenty-five-foot channel to the sea by the construction of controlling works and dredging. The estimated cost was about $2,800,000. The port of Portland, using funds obtained from taxation in Portland, has co-operated to the extent of providing about $1,700,000. Up to June 30, 1904, the national government had applied about $1,500,000 on this portion of the river. Turning to the main lower branch of the Columbia, the Willamette, the situation calls either for the purchase of the existing canal and locks at the falls from a private corporation or the construction of a new system of locks and canal. The board of engineers that investigated this matter in 1899 recommended an expenditure of $456,000, either for the acquiring of the present canal and locks, or the building of new ones. The corporation owning the existing improvements declines to sell at the valuation placed upon them by the board of engineers, though the board arrived at its figures through capitalization of the net earnings from the canal at fair rate of interest as well as by

estimates based on cost of reconstruction. Though these locks were built thirty-five years ago (the state furnishing $200,000, about two-thirds of the cost of construction), the legislature of Oregon, in 1907, appropriated $300,000 "contingent upon the United States appropriating the sum of $300,000, or a sum sufficient to acquire by purchase, condemnation, or construction," a canal around the falls at this place. In the Willamette, above these falls, the problem of improvement is quite similar to that, say, of the Illinois River. The Willamette drains the bed of a former arm of the ocean and has not the firm banks of the upper Columbia and its tributaries. These represent channels worn in a sheet of lava that was universally spread over that region. Something like half a million has been used on the upper Willamette and its tributaries, mainly in dredging and snagging, in other words, in maintenance.

At the cascades the project that was adopted in 1877 was not completed in modified form, so as to be open to navigation, until 1896. It has cost some $4,000,000, and provides for the passage of boats of a maximum draft of seven feet. But to open the river at the cascades without opening it at The Dalles-Celilo obstructions, forty-five miles above, answers comparatively little purpose. The "Inland Empire" lies on beyond Celilo Falls. The problem presented by these latter obstructions seems to have quite appalled the earlier engineers. Several projects have in turn been recommended for overcoming these obstructions. The first contemplated a canal and locks and some straightening of the river at an estimated cost of over $10,000,000. A plan for a boat railway was next adopted and appropriations were even made for entering upon the construction of it. It was expected to cost $3,000,000. The river men objected and the engineers do not seem to have been quite sure of its practicability. The project that now stands contemplates a continuous canal sixty-five feet wide at the bottom and eight feet deep. The canal is to have four locks and is estimated to cost something over $4,000,000. As the Secretary of War conditioned the beginning of work upon it upon the United States securing the right of way free of cost, the State of Oregon purchased the right of way at a cost of $70,000 and conveyed it to the United States. In order to obtain some relief for the producers in the region above this point from the exorbitant freight charges of the railways, the State of Oregon had also, in 1906, at a cost of $165,000, built a portage railroad around the obstructions.

The improvements in the main river and its tributaries above Celilo Falls consist mainly in blasting obstructing rock and boulders, raking gravel bars and building concentrating dikes. These had, up to June, 1904, cost some $300,000. There are more recent recommendations for additional improvements to the amount of $400,000 more. The wisdom of having as much as possible of the upper river and its tributaries in good navigable condition at the time of the completion of The Dalles-Celilo project is evident.

The effect to be anticipated from an "open river" on freight charges may be illustrated in several ways. The present rate on wheat from Lewiston-Clarkson, Idaho (a little below the head of navigation on the Snake), to Portland is $5.20 per ton. A most reliable river captain holds that this rate would be reduced to a figure between $1.60 and $2.10 per ton. As the rates on heavier commodities along the Mississippi, per ton mile, are about one-tenth of the present rail rates along the Snake and Columbia waterways, such an estimate seems reasonable. For a distance of eighty-eight miles, from Portland to The Dalles, the rate on salt is $1.50 per ton on car-load lots, and $3.00 on less than car-load lots. The corresponding figures for a distance 100 miles farther, to Umatilla, where no river competition exists, are, respectively, $7.50 and $12.00 per ton, or four times the water rates.

The area drained by the Columbia and its tributaries comprises some 250,000 square miles. While there is more waste area in this than in an equal area of the Mississippi basin, it must be taken into consideration that some of this and in widely separated sections is selling at $1,200 an acre. The additional value that will be given to this vast area by an "open river" will make the cost of the improvements of the Columbia seem very small. That improvement will call into active operation many industries that wait only for the presence of reasonable transportation facilities to spring into life. The extension of irrigation enterprises will only equalize the flow of the streams in a salutary way for the interests of navigation. With the waterways of the Columbia basin open, as the expenditure of a reasonable sum will suffice to improve them, the Pacific Northwest will probably equal in wealth any other most favored section of like area in the country.

With the projected improvements completed, and a few more minor ones on the upper Columbia, the Pacific Northwest would

have transportation facilities comparable with those that will be possessed by the Trunk line territory when New York's project for making a ship-channel of the Erie Canal is completed. What the Pacific Northwest system would lack in the size of cargo it could float it would make up in being a more direct route and in being available during more months of the year.

RECLAMATION OF ARID WEST BY FEDERAL GOVERNMENT

By Arthur P. Davis,
Chief Engineer United States Reclamation Service.

When the President approved, on June 17, 1902, a bill known as the Reclamation Act, the United States entered upon a policy of internal improvement along novel lines. Many millions have been spent upon internal improvements, but none of them on a commercial basis, that is, the beneficiaries of the expended funds have never been required to return the cost of the improvements as is required by the Reclamation Act.

The preliminary stage of survey and examination for the selection of projects is now practically passed. The second stage of construction is well advanced and large areas of land have been placed under irrigation. The third stage, that of settling the various projects with prosperous settlers and collecting from them the cost of the works, has just been entered upon. The novelty of this feature, together with other important obstacles constitutes this third stage the most difficult of all.

In all, twenty-six projects have been approved by the Secretary of the Interior and construction has commenced on twenty-five of these, several having been nearly completed. On the passage of the law, a sum of money amounting to nearly $5,000,000 was made immediately available by the terms of the act. During the stage of organization, survey, and examination, the expenditures were relatively light and the fund continued to accumulate under the provisions of the law by the sale of public lands in the West. As construction was undertaken, however, the expenditures increased, and as new projects were taken up the increments augmented until now the accumulated funds have practically been exhausted, and during the future years the outlay will probably be governed by the current receipts from various sources.

Salt River Project, Arizona

About twenty years ago began a series of years of unusually large run-off in the Salt River basin in Arizona. The successive high-water periods, showing a large amount of surplus run-off year after year, attracted public attention and encouraged the construction of canals and development of irrigation until these enterprises reached far beyond the capacity of the river in ordinary years. In 1898, like the backward swing of the pendulum, began a series of unprecedented dry years, the run-off for several years being below the yield during the recollection of the oldest inhabitant.

The hot arid climate makes all crops absolutely dependent upon irrigation in this region, and long-continued drought led to the death of large and valuable orchards, vineyards and alfalfa fields upon which great expenditures had been made. In attempting to save property in all parts of the valley hardship was caused even to the oldest irrigators with the best water rights. Under these circumstances the legislature of Arizona provided for preliminary investigations of the feasibility of water storage on upper Salt River, which were carried out in co-operation with the Geological Survey in 1901. A large and feasible reservoir site was surveyed and a foundation for a dam explored with diamond drills.

Unusual difficulties were presented by the isolation of the locality and the extreme roughness of the surrounding country, which was of a volcanic origin and scored by profound box canyons. Those conditions made it extremely expensive to import large quantities of heavy articles, such as cement and fuel. Investigations revealed the presence of suitable materials for the manufacture of cement at the dam site, but the large quantity of fuel required for the necessary power for manufacturing the cement and building the dam presented great difficulties. The little wood that was available was scattered and of poor quality. It was decided to develop water power by diverting the river and carrying it through canals and tunnels for a distance of about eighteen miles and dropping it about 250 feet. The towns of Phœnix and Mesa co-operated in the construction of a road by issuing over $70,000 in bonds for the purpose. Fuel oil imported from California is freighted from Mesa over this road. This oil is used in the kilns

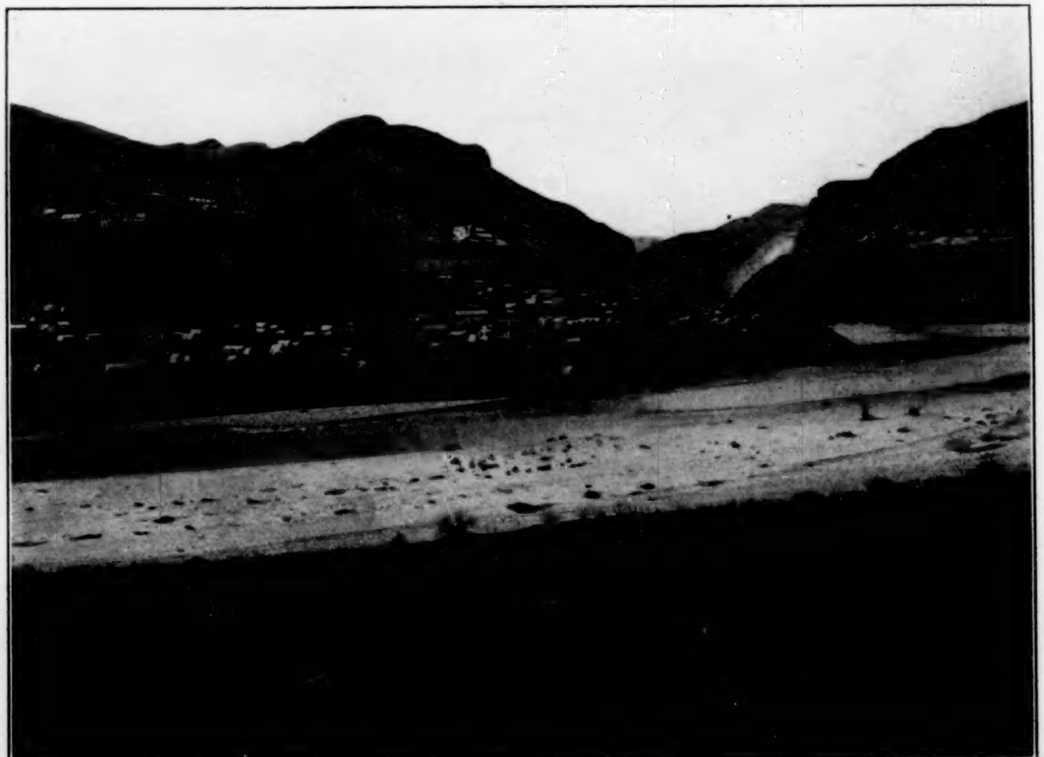

PLATE I.—Roosevelt dam site, looking down-stream. Buildings in upper left, engineers' camp; upper center, cement mill and sand crusher; on the right, contractor's camp; lower bench, temporary town of Roosevelt, which will be submerged when reservoir fills.

for burning cement, and water power is used to run machinery in the cement mill and to handle the rock and mortar for the dam.

The little sand that occurs in this vicinity is badly mixed with adobe mud and is of very poor quality. It was found that a much higher grade of sand could be manufactured by crushing dolomite, which occurs conveniently near the dam site, and a mill was erected for this purpose. In the foundations of the various mills and buildings large quantities of lime were used, which were also burned at the dam site. Such works as those always require large quantities of lumber for concrete forms and temporary works of various kinds. It was found feasible to install a saw-mill in the neighboring mountains for this purpose, and about 3,000,000 feet of lumber have been sawed and delivered upon the work.

The dam on Salt River is to be built just below the mouth of Tonto Creek, where the river flows through a profound gorge. From foundation to coping the dam will be about 280 feet high, and the reservoir will have a capacity of about 1,300,000 acre feet. The power developed for the construction of the dam will, after its completion, be transferred to the valley for pumping water from wells to increase the water supply for irrigation. Arrangements have also been made for transferring a portion of this power to the Gila River Indian Reservation for supplying the Indians with irrigation water by pumping.

The contract for this dam was let to James O'Rourke and Company, of Galveston, Texas, in April, 1905. Since the contractor began work an unprecedented series of excessive floods have greatly hampered the work, having washed out the contractor's coffer-dam four successive times and filled up excavated portions of the foundation. The contractor has, however, succeeded in placing the foundation in the river and bringing the upstream portion of it to the top of his coffer-dam, so that such disasters are not to be feared in the future.

The great flood of November, 1905, also washed out the Arizona Dam, just below the mouth of Verde River, which served as a diversion dam for the Arizona Canal and the other canals on the north side of Salt River. This north-side system was purchased by the Secretary of the Interior with reclamation funds in 1906, and a concrete dam for diverting water into it is being constructed at a granite reef, below the old Arizona Dam. The

entire canal system on the north side of Salt River, serving at present over 60,000 acres of land, is being operated by the reclamation service, a temporary dam being maintained in the river at the head of the canal, pending the completion of the concrete structure below.

The storage system under construction is expected to serve an area of 180,000 acres of land in this valley, which can be increased by the extension of pumping development with the power available from the project until the limit of the underground water supply is reached. The reservoir dam is 25 per cent completed. The Granite Reef Dam is 38 per cent completed. The Salt River project as a whole is 62 per cent completed.

Yuma Project, Arizona-California

The Yuma project provides for the construction of a diversion dam across Colorado River about ten miles northeast of Yuma, Arizona. From this diversion dam two canals will be built; the one in Arizona to cover about 83,000 acres of land, and the one in California, about 17,000 acres. The project provides for an efficient means of sluicing out the head of the canal by utilizing the fall secured by the dam. The dam will have a total length of 4,780 feet, a maximum width of 257 feet, and a maximum height of 19 feet. The work on the dam was begun July 20, 1905; but the contractors made slow progress and it was finally taken up by the government under force account.

One of the chief difficulties encountered was the transportation of fuel and other supplies from the railroad to the dam site. The roads were very bad and the navigation of the river so poor that it was frequently impossible to keep the machinery supplied with fuel. It is now the intention to build a railroad from the main line of the Southern Pacific to the dam site on the California side of the river. As soon as this is completed, work will be actively pushed on the dam, and it is expected that some water will be turned into canals in 1908, though the full season's supply cannot be furnished until 1909.

Orland Project, California

The Orland project contemplates the storage of water in the foothills on the headworks of Stoney Creek and its diversion and

PLATE II.—Main south canal, Uncompahgre Valley. Lined canal section through clay foothills.

use in the vicinity of the town of Orland, California. Options have been obtained for the rights of way necessary on the reservoir site and also for the two existing ditches near Orland. Negotiations are completed with the Central Canal and Irrigation Company, for the amicable adjustment of claims to the waters of Stoney Creek, which will remove all complications of this nature. Prospects are good for the beginning of active construction during the year 1908 for the irrigation of about 15,000 acres of land. The project, however, is susceptible of considerable extension beyond this point by the utilization of other reservoir sites and by pumping water from the underground supply. This project is regarded as an integral part of the general development of the Sacramento Valley.

Uncompahgre Valley Project, Colorado

The Uncompahgre Valley in Colorado has been irrigated for many years, and the development of irrigation has proceeded beyond the available water supply of the Uncompahgre River, some of the waters originally appropriated having been diverted by later ditches in the valley above. To relieve this condition, and also to bring under irrigation a large area of land in the valley still unwatered, the Reclamation Service undertook the construction of a tunnel through the mountain range to bring water from the Gunnison River into the Uncompahgre Valley. The length of the tunnel is 30,515 feet, and the works include a number of small tunnels and a great deal of heavy construction in canals through rough country.

The contract for the construction of the main tunnel was let, in 1904, to the Taylor-Moore Construction Company, but financial difficulties caused its abandonment by the contractor on May 27, 1905. Since that time it has been prosecuted by day labor under the engineers of the Reclamation Service. The work has presented a great many difficulties. For a considerable distance the western half of the tunnel follows almost directly under the bed of Cedar Creek, which is composed of loose sand, gravel and mud. In May, 1905, this channel broke through the contractor's temporary timbering, causing an extensive cave-in and resulting in the death of six persons. In August, 1907, Cedar Creek broke through the lining of the tunnel at two different times and places, bringing in large quantities of mud, sand, and gravel, and causing delay to the

work. No one was injured by these accidents, however. On December 22, 1906, the drills in the west heading struck a strong flow of water under high pressure, discharging about seven cubic feet per second, and heavily charged with carbon dioxide. The gas quickly filled the tunnel and drove the men out. In order to properly ventilate the tunnel thereafter it was found necessary to sink a shaft near the heading, which involved a shaft of about 700 feet. The work was greatly delayed from this cause, but the water was drained out and the tunnel was cleared of gas so that work was again resumed. Smaller quantities of gas have from time to time been struck in various parts of the tunnel, causing danger and delay, but no lives have been lost thereby. On July 16, 1907, a heavy flow of water was encountered at the eastern heading, which flooded the machinery and drove the men from work. It was more than a month before work could be resumed at this heading. Large quantities of water have been encountered from time to time in both headings, always causing delay and heavy expense. On November 30 the progress of excavating this tunnel was as follows:

East heading	7,933	feet
West heading	14,338	"
Total	22,271	feet
Lining (tunnel complete)	7,781	feet
Distance between headings	8,244	"

The Uncompahgre Valley project was, as a whole, 74 per cent complete on the above date.

Minidoka Project, Idaho

The Minidoka project diverts water from Snake River near the station of Minidoka, Idaho. About 60,000 acres on each side of the river will be irrigated from this diversion point and the canal system for the north side has been completed. A portion of the lands on the south lie above the possibility of gravity distribution, and require the construction of a large dam and the development of power which can be made available at the dam site. The dam was constructed by the Bates and Rogers Construction Company, and is about fifty feet high. Water from this system was deliv-

PLATE III.—Minidoka Dam, looking south. Diversion dam on Snake River, 50 feet high, showing towers and cableways, from which rock was placed. Gates of north side canal in foreground. Power units will be installed in the bays in main dam to develop about 10,000 horse-power from the water passing through to supply prior rights below.

PLATE IV.—Huntley canal, looking east. Opened by Secretary Garfield, June 26, 1907. Town of Huntley in the distance.

ered in May to a portion of the land, and about 18,000 acres have been actually cultivated. All the public land for which water is available has been taken and extensive improvements have been made by settlers.

Payette-Boise Project, Idaho

Payette-Boise project provides for the storage of waters of both the Payette and Boise Rivers by storage reservoirs on each stream. The land to be reclaimed is mainly in the Boise Valley, and a large portion of the waters of Payette River are to be brought into the Boise Valley. The unit now under construction involves a dam on the Boise River, which is more than half completed. A large canal will conduct water from this point for storage to a basin known as the Deer Flat reservoir. Two large earthen embankments are required to form the reservoir basin. These embankments are under construction, one by contract and the other by force account. Satisfactory progress has been made, and it is expected that this unit will be completed in 1908.

Garden City Project, Kansas

The Garden City project will obtain water for irrigation by pumping from underground. For this purpose a power plant has been constructed at Deerfield, Kansas, consisting of steam turbines driving electric generators from which the power is delivered to twenty-three separate pumping stations, which will supply water to about 8,600 acres, situated in the vicinity of Garden City. The power plant is practically completed and some of the pumping stations are ready for tests. Water will be furnished to most of the land during 1908, the old existing canal system being used for this purpose.

Huntley Project, Montana

The Huntley project provides for the diversion of water from the Yellowstone River at a point about three miles above Huntley, Montana, on the south bank. The canal and tunnels necessary for this diversion have been constructed to cover more than 20,000 acres of land, and the project as a whole will include about 30,000 acres, twelve miles from the source of the canal. There is a great

deal of side-hill work which is very difficult and expensive, and it is found necessary to drop the water to a lower level for the major portion of the lands. The power generated by this fall is used to pump a portion of the water to a higher level to command lands on the top of the mesa. This pumping plant has been completed and will be in operation in 1908. The lands to be reclaimed form a portion of the area which the Crow Indians by treaty ratified by Act of Congress approved April 27, 1904, ceded to the United States. They were formally opened to settlement on June 26, 1907, and a considerable number of entries have been made for which water will be delivered in 1908.

Sun River Project, Montana

The Sun River project provides for the irrigation of a large acreage on both sides of Sun River and the construction of a number of reservoirs for regulating the waters. The first unit, authorized in March, 1906, is now under construction and will irrigate about 18,000 acres in the vicinity of Fort Shaw, for which water will be regulated in a small reservoir on Willow Creek. The main canal for the Fort Shaw unit is under construction and work has been begun on the lateral system. The outlet tunnel and other preliminary work on the Willow Creek reservoir are almost completed. It is expected that a small acreage of land under this unit will be offered for settlement in 1906.

North Platte Project, Wyoming-Nebraska

The North Platte project involves the construction of a reservoir on the North Platte River about fifty miles above Casper, Wyoming, to hold the winter and summer flood waters for use during the low-water period of the late summer, the normal flow of the late summer having been already appropriated and applied to beneficial use by farmers on the lower river, mainly in Nebraska. The reservoir, which has been named the Pathfinder, will have a capacity of 1,000,000 acre feet, and the dam will be about 200 feet high. The contract for this construction was let to the Geddes and Seerie Stone Company, in 1905, and is 40 per cent completed. The contractors are making very satisfactory progress and doing excellent work. It is expected that the dam will be completed

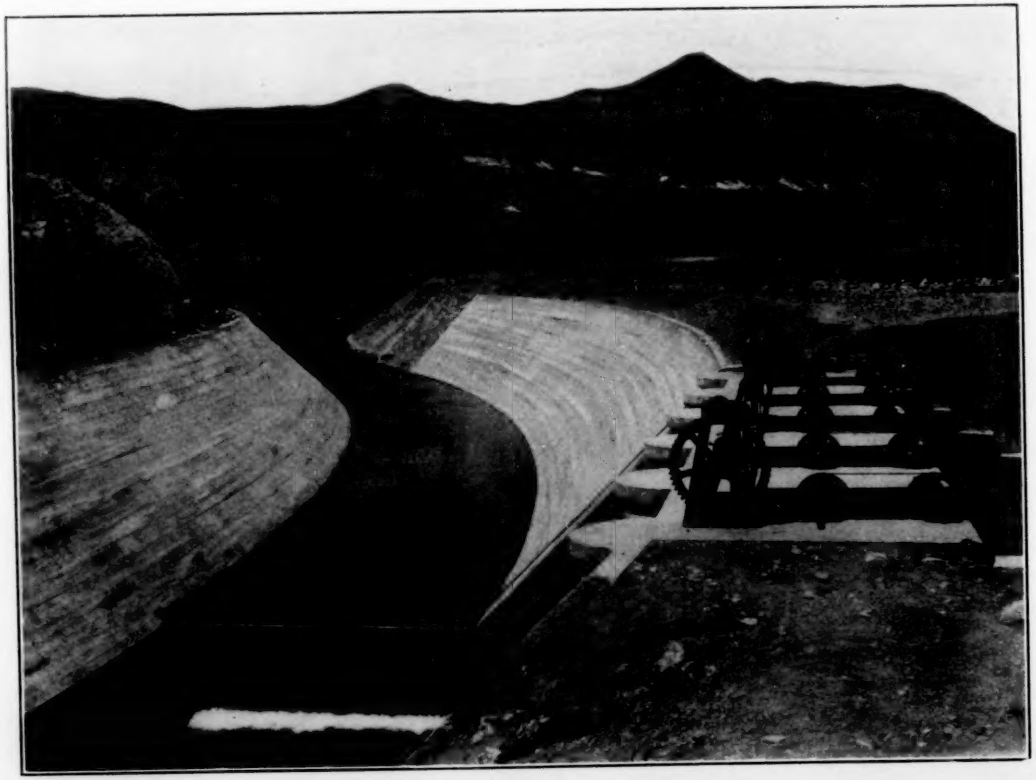

Plate V.—Wasteway of Truckee main canal, Truckee-Carson project, Nevada.

about the end of 1908. The water stored in the Pathfinder reservoir will be diverted for irrigation at various points on the lower river and both sides of the line between Wyoming and Nebraska. At present a diversion dam is under construction by the S. R. H. Robinson and Son Construction Company, near the station of Whalen, Wyoming, on the Burlington road. Satisfactory progress has been made with this dam and it will be completed early in 1908. From this point a canal, with a capacity of 1,400 cubic feet per second, has been constructed and nearly completed to a point about 100 miles eastward, situated nearly northeast of Scottsbluff, Nebraska. This canal at present covers nearly 30,000 acres in Wyoming, and about 75,000 acres in Nebraska, 40,000 of which it is expected will be ready for irrigation in the year 1908. Water was turned into the canal May 5, 1906, and was used for irrigation during that summer upon certain tracts in Wyoming. Its use has been extended during the past season. Construction is being pushed upon the distribution system, and it is expected that over 40,000 acres can be irrigated in Nebraska the next irrigation season.

Truckee-Carson Project, Nevada

The Truckee-Carson project consists of the diversion of waters of Truckee and Carson Rivers upon the adjacent lands, mostly lying in the lower Carson basin. The Truckee waters are carried by a large conduit of 1,400 second feet capacity to the Carson River, a small amount of the water being distributed upon the divide between these rivers. A large diversion dam in the Carson River has been constructed and the water is carried through a large canal to the land south of the Carson River, a small area on the north side being commanded also by a smaller canal. At present 100,000 acres of land are ready for settlement and about 30,000 acres are actually under cultivation. Lake Tahoe will be used as a storage reservoir to serve this project. With the regulation accomplished by this reservoir it will be possible to irrigate about 150,000 acres of land. Several other reservoirs are also contemplated, which will greatly extend the area to be covered. Considerable vacant land on this project is now under irrigation and available for homestead entry under the Reclamation Act.

Carlsbad Project, New Mexico

The Carlsbad project was constructed by private enterprise in the early '90's, but was not successful, either physically or financially. After contending with washouts and various other disasters, the proprietary company in 1905 found itself unable to replace the Avalon dam, which was destroyed by a flood in 1904, and upon which the canal system depended for its supply. The property was transferred to the United States and the Reclamation Service undertook its rehabilitation. Water was delivered to a portion of the lands in May, 1907, and about 20,000 acres will be placed under irrigation in 1908.

Hondo Project, New Mexico

The Hondo project, now practically completed, provides for the diversion of waters of Hondo River into a basin constructed to the north of the river from which the stored waters will be discharged into the channel of the Hondo River below, and diverted upon lands in the vicinity of Roswell, New Mexico. This project contemplates the reclamation of 10,000 acres of land, and some water may be delivered for irrigation in 1908.

Rio Grande Project, New Mexico-Texas

The Rio Grande project contemplates the construction of a large storage reservoir between San Marcial and Engle stations on the Santa Fé Railroad. This reservoir will have a capacity of about 2,000,000 acre feet, and will be ample to completely regulate the entire flow of the Rio Grande at this point. The stored waters will be diverted at various points below to irrigate about 180,000 acres of land, a small portion of which is now under cultivation, with a very uncertain water supply, from the natural flow of the river. By treaty with Mexico 60,000 acre feet of this water will be delivered annually at the head of the Mexican ditch near El Paso for use upon the Mexican side. For this reason Congress made a direct appropriation of $1,000,000 for the payment of a portion of the expense of this project, which is estimated to cost about $8,000,000. A diversion dam is now under construction and nearing completion in the vicinity of Fort Selden, which will divert the unregulated waters into existing canals. The dam will be of concrete and will be ready for service in 1908. Only preliminary work has yet been done upon the reservoir.

PLATE VI.—Outlet tower, Hondo reservoir, New Mexico.

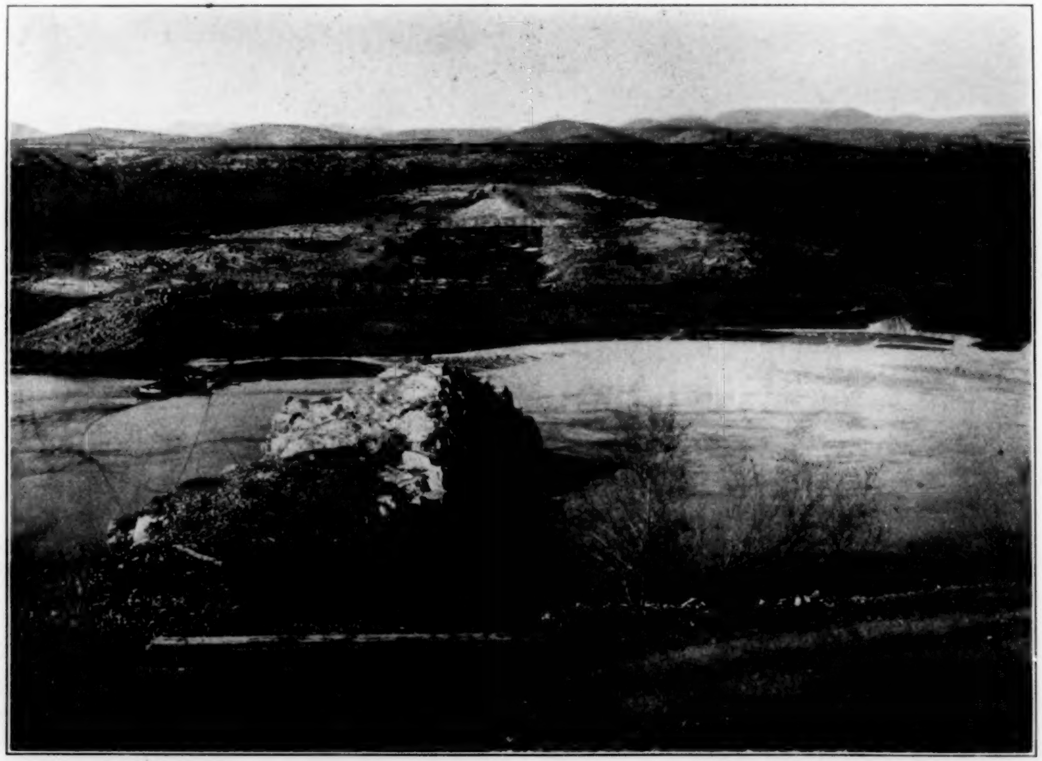

Plate VII.--Site of Leasburg Diversion Dam on Rio Grande. Under construction. Canal gates will be set in Penasco Rock in foreground. Concrete dam will extend from Penasco Rock to join embankment in distance.

Lower Yellowstone Project, Montana-North Dakota

The Lower Yellowstone project will irrigate lands on the left bank of the Yellowstone River, beginning at a point about twenty-five miles below Glendive, Montana, and extending to the junction of the Yellowstone and Missouri rivers. The river will be diverted by a timber and stone dam about twenty miles below Glendive, and the canal will be constructed in heavy cut for several miles eastward from this point until it emerges on the surface of the ground. The project will irrigate about 70,000 acres of land, about two-thirds of which is in Montana and one-third in North Dakota. It involves much heavy construction and includes one direct pumping plant where the power, generated by water falling from the canal to the level of the bottom lands, will be utilized to lift a portion of the water to a bench above the canal and cover about 3,000 acres of additional land. Construction on the main canal is in an advanced stage and a large number of the laterals are nearing completion. It is expected that water will be delivered to a large portion of the land some time in 1908.

Buford-Trenton and Williston Projects, North Dakota

Two pumping projects are under construction on the left bank of the Missouri River which will develop power by the use of the lignite which occurs in the vicinity.

At Williston a large power station has been constructed at the mouth of the lignite mine, and power is transmitted to a pumping plant on the river near Williston and to another pumping plant at Buford. From these pumping plants the water will be discharged in canals to valley lands from Buford to Williston. These pumping plants are in an advanced stage of construction and will be ready to deliver water some time in 1908.

Klamath Project, Oregon-California

The Klamath project is an interstate project involving the reclamation of lands in Oregon and California in the vicinity of Klamath Falls, Oregon, by the use of the waters from upper Klamath Lake and of Lost River. A large canal from upper Klamath Lake to Lost River has been completed by contract, and water was delivered in the past season to lands along its course. The power canal on the right bank of Link River is being constructed,

which will furnish power for local use and supply the needs of the company whose enterprise will be superseded by the government canal. This canal will be extended to the right bank of the Klamath River.

Umatilla Project, Oregon

The Umatilla project diverts the water from Umatilla River and carries it through a long conduit to a reservoir near Cold Springs, formed by building a dam across a dry ravine. The headworks and feed canal have been constructed under contract, and work by force account is being vigorously pushed upon the Cold Springs dam. It will be an earthen structure, and the reservoir will have a capacity of 50,000 acre feet. Work is also being pushed on the outlet canal and distribution system and it is expected that a small acreage can be irrigated during the coming season, although it will be impossible to complete the project before 1909.

Belle Fourche Project, South Dakota

The Belle Fourche project utilizes the waters of Belle Fourche River by diverting them at a point near the town of Belle Fourche and carrying them to a reservoir, to be constructed on Owl Creek at its junction with Dry Creek. The diversion dam and a feed canal, both of which are large structures, have been completed, and work is being carried on under contract on the large earthen dam across Owl Creek. Extensive work has also been done on the main canal and the distribution system. Some land will be placed under irrigation in 1908 and is now ready for settlement.

Strawberry Valley Project, Utah

The Strawberry Valley project provides for a storage reservoir on Strawberry Creek, a tributary of Duchesne River, Utah. The stored water will be carried through a tunnel about four miles in length, discharging into Diamond Creek, a tributary of Spanish Fork River. The water will be delivered from the Spanish Fork and utilized upon about 40,000 acres of land in the vicinity of the town of Spanish Fork. Preliminary work for this project is under way. The western end of the tunnel has been opened up and a power plant is being constructed for the development of

electric power for construction in the tunnel. The canal used for this power plant will also be utilized for the conduction of the waters to the irrigable lands when these are available. It is expected that the power plant will be completed and active work begun on the tunnel in the spring of 1908. The project, however, will require several years for its completion. In the meantime the canal system can be used for delivering the flood waters of Spanish Fork to the lands which will later receive a full supply.

Okanogan Project, Washington

The Okanogan project in northern Washington provides for the storage of water on Salmon River and its diversion at a point lower down to cover bench land lying between Alma and Riverside on Okanogan River. Work is now in progress on the Salmon Lake reservoir and also on the canal system, and is being vigorously pushed by force account.

Sunnyside Project, Washington

The Sunnyside Canal system of the Washington Irrigation Company was purchased by the Secretary of the Interior, and is being enlarged and improved for the better service of a larger area of land. The old wooden headworks have been removed and permanent works of concrete of larger capacity have been built. The diversion dam partly washed away during the flood in the spring of 1907, and a permanent dam of concrete is being built in its place. It is expected that this dam will be completed the present autumn. The wasteway below Zillah is being reconstructed and put in safe condition to carry the water of the canal when repairs or other emergencies render this necessary. The water for the extension of irrigation under this system will be provided by storage in Lakes Kachess, Keechelus, and Clealum, on the headwaters of Yakima River. Temporary controlling works have already been installed at the two former points and permanent dams below the lakes will eventually be built.

Tieton Project, Washington

The Tieton project receives its water supply from the Tieton River, northwest of the City of North Yakima, and carries it along the canyon wall and over the divide into the Cowiche Basin,

where an area of about 30,000 acres can be commanded. The work in the canyon is very heavy, requiring side-hill canyon in rock and a large amount of tunneling. This work is now under way, the excavation and tunneling being done by the government under force account and the canal lining under contract. The power plant for excavating these tunnels has been constructed on the Tieton River and is now in operation, furnishing power to the drills and ventilating machinery. The canal system in Cowiche Valley is under survey and will soon be ready for construction. The waters utilized for this project are appropriated lower down from the Naches River into which the Tieton flows. The water to be diverted from the Tieton will be supplied to the prior appropriators on the Naches by storage in Bumping Lake reservoir, the construction of which will be undertaken next year.

Shoshone Project, Wyoming

The Shoshone project contemplates the storage and complete control of the waters of the Shoshone River by the construction of a dam 310 feet high, eight miles above Cody, Wyoming. The contract for the construction of this dam was let to Prendergast and Clarkson in 1905, but this firm failed and their bondsmen, the United States Fidelity and Guaranty Company, executed a contract with the Secretary of the Interior for the construction of the dam. Temporary diversion works have been completed and the contractor is engaged upon excavating for the foundation of the dam. The work has been delayed by washout of the temporary diversion works, but these have been restored and things are in shape for pushing the work rapidly. The reservoir to be formed will have a storage capacity of about 420,000 acre feet. The water will be allowed to flow down the river and diverted at various points, the principal one being at the Corbett Dam, which is under contract and nearly completed. From this diversion dam water flows through the tunnel known as the Corbett tunnel, about 18,000 feet in length, and emerges on top of the mesa. This tunnel was originally under contract, but the contractor failed and the work was completed by the government on force account. The canal system is now under construction by contract, and it is expected that water will be ready for delivery to about 15,000 acres of land in May, 1908, between the stations of Ralston and Garland along the Bur-

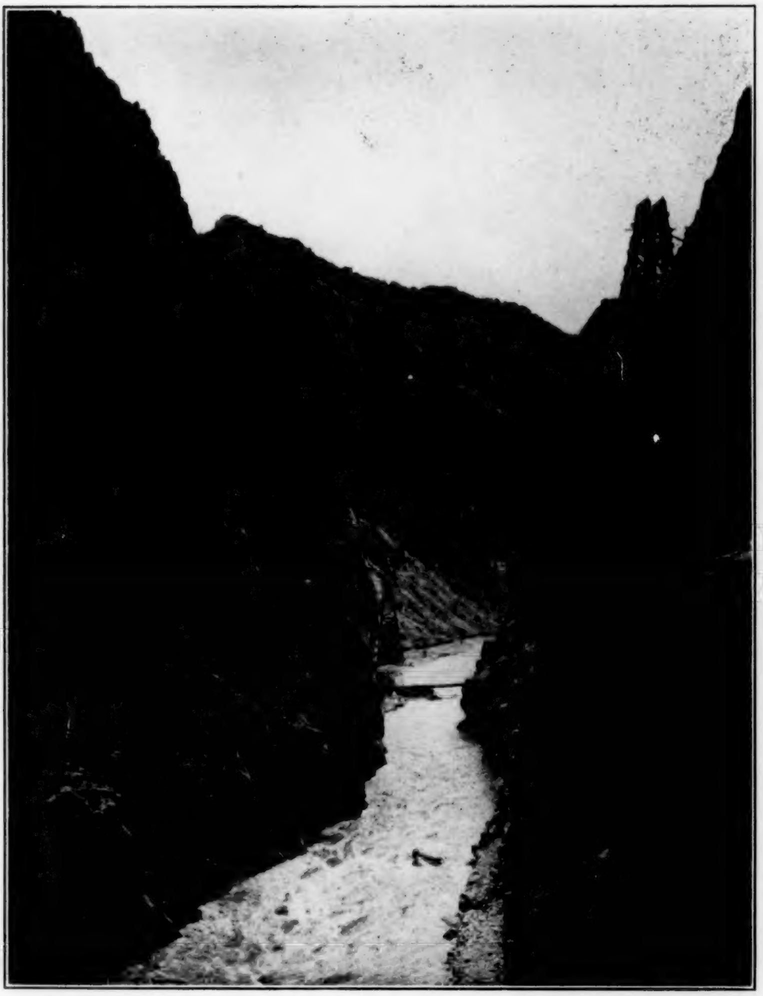

PLATE VIII.—Site of Shoshone Dam, Wyoming, looking up-stream. Under construction. Height from foundation to coping 310 feet. It will be the highest dam in the world.

lington Railroad. Additional areas will be covered by the distribution system and placed under irrigation as settlement demands.

The total amount expended from the Reclamation Fund to December 31, 1907, is $33,300,000. The amount available for expenditure during the calendar year 1908 is approximately $7,000,000. The projects now approved and in process of construction, with the irrigable acreage which will be placed under cultivation within the next few years, are as follows:

Project.	Estimated cost.	Irrigable acreage.
Salt River, Arizona	$5,300,000	200,000
Yuma, California-Arizona	4,500,000	100,000
Orland, California	1,500,000	30,000
Uncompahgre, Colorado	6,200,000	140,000
Grand River, Colorado	2,500,000	50,000
Minidoka, Idaho	2,000,000	80,000
Payette-Boise, Idaho	3,600,000	120,000
Garden City, Kansas	320,000	8,000
Huntley, Montana	900,000	30,000
Sun River, Montana	500,000	16,000
North Platte, Nebraska-Wyoming	4,100,000	118,000
Truckee-Carson, Nevada	4,500,000	150,000
Hondo, New Mexico	336,000	10,000
Carlsbad, New Mexico	600,000	20,000
Rio Grande, New Mexico	200,000	10,000
Lower Yellowstone, Montana-North Dakota	2,700,000	67,000
Buford-Trenton and Williston, North Dakota	1,000,000	30,000
Klamath, Oregon-California	1,400,000	50,000
Umatilla, Oregon	1,140,000	20,000
Belle Fourche, South Dakota	3,400,000	100,000
Strawberry Valley, Utah	1,350,000	35,000
Okanogan, Washington	500,000	9,000
Tieton, Washington	1,400,000	24,000
Sunnyside, Washington	2,000,000	50,000
Wapato, Washington	600,000	20,000
Shoshone, Wyoming	4,500,000	100,000
Total	$57,046,000	1,587,000

Some of the above projects are capable of greater extension beyond that indicated above. In addition to this a number of large projects have been investigated and found feasible, but not

yet taken up. No detailed estimate of acreage or cost has been made of such projects, but the following table shows a rough approximation on these points:

Projects.	Estimated acreage.	Probable cost.
Little Colorado, Arizona	80,000	$ 4,000,000
Sacramento Valley, California	500,000	20,000,000
San Joaquin Valley, California	200,000	8,000,000
Colorado River, Colorado, Utah, California, Arizona	750,000	40,000,000
Dubois, Idaho	100,000	4,000,000
Lake Basin, Montana	300,000	12,000,000
Las Vegas, New Mexico	35,000	2,100,000
Urton Lake, New Mexico	45,000	2,000,000
Walker and Humboldt Rivers, Nevada	500,000	15,000,000
Red River, Oklahoma	100,000	4,000,000
John Day River, Oregon	200,000	10,000,000
Weber, Utah	100,000	5,000,000
Big Bend, Washington	750,000	30,000,000
Goshen Hole, Wyoming	120,000	5,000,000
Totals	3,780,000	$161,100,000

THE RELATION OF FORESTS TO STREAM CONTROL

By Hon. Gifford Pinchot,
United States Forester, Washington, D. C.

The phenomenal development of industry and the consequent increased demand for transportation have turned attention to our most natural means of inland transportation—the lakes and rivers. It has forced us to realize that our streams, in spite of the tens of millions of dollars appropriated for their development, are becoming less navigable. Increasing amounts of sediment are deposited each year in their middle and lower courses, while the flow of the streams themselves becomes less regular. Navigable with difficulty, if at all, during the summer, they become turbulent and turbid during the spring, overflow their banks, and often carry destruction to life and property. The skill of our engineers is taxed to the utmost to keep harbors and rivers free from the constantly recurring deposits of sediment. Because of the rapidly increasing tonnage and draft of vessels, it is not sufficient merely to maintain the present depth of our rivers and harbors. Their depth must be constantly increased or they will gradually fail to accommodate the larger vessels, and such of them as fail must finally be abandoned altogether.

More powerful dredging machinery is constantly coming into use. Efforts are common to prevent the deposit of sediment by confining streams to channels narrow enough to accelerate the current and so lessen the rate of deposition. This method of channel adjustment has accomplished great good in improving the courses of many of our rivers, but it cannot and does not claim to regulate in the least the water supply of the streams.

The method of storage reservoirs, extensively tried in France, has been suggested as a method of river improvement in the United States. Reservoirs filled in the spring freshet season serve to increase the flow later in the year when the streams run low. Floods may thus be prevented, and the immense loads of silt which they would otherwise have brought down are thus kept from being dropped by the slow current in the lower channel. Theoretically

this method of storage reservoirs will accomplish all that can be desired in regulating stream flow and preventing excessive deposition, if only adequate storage capacity is available. In practice, too, it will doubtless be efficient in places where the erosion is not rapid. But the great disadvantage of this method, as is proved by the experience of the French engineers, lies in the fact that the reservoirs themselves become clogged with detritus and must sooner or later, varying with the forest conditions and the character of the topography drained, be either abandoned or maintained by constant clearing out at large expense.

The engineers of the United States Reclamation Service fully realize that the amount of solid matter carried by a stream is a very serious problem in connection with the construction of storage reservoirs for irrigation purposes. Streams from barren watersheds abound in violent freshets which carry with them eroded sediment, to be deposited in the first pool of still water they encounter, and thus reduce the storage capacity of the reservoirs into which they flow. Mill dams completely filled with sediment are to be seen everywhere, and offer good demonstrations of the damage to storage reservoirs from silting.

The regulation of streams by storage reservoirs is really an imitation of what nature is able to accomplish by the forests. Forests at the sources of the streams are veritable storage reservoirs, and without them no artificial remedy can be either adequate or permanent. Erosion destroys reservoirs, and must be controlled if reservoirs are to succeed. This can be done only by conserving or restoring the forests. The forest cover alone can reduce the amount of sediment carried by water, and make possible the permanent improvement of inland waterways. To check erosion by reforestation, work must begin in the highlands, because there the slopes are steepest, the rainfall greatest, and the action or frost most considerable, and therefore the process of erosion is most rapid and the results most destructive.

No one will deny the necessity for engineering methods to cope with the moderate deposits of silt and the seasonal irregularities in flow, which may indeed be lessened by forest cover, but which are unavoidable so long as the sun shines and the rain falls. Yet it remains true that a forest cover interposed between rain and rock affords the best natural means for regulating streams and reducing

the loads of detritus. Without such a forest cover every attempt to improve the regimen and the channel of a stream will be little more than a temporary expedient.

Both wide experience and scientific investigation have shown that there are two functions exercised by the forest in relation to stream-flow.

1. Its tendency to reduce the difference between high and low water, an influence which is of most importance in the distribution of flood crests, and in maintaining a steady flow of water during the different seasons of the year and during cycles of dry and wet years.

2. Its value as a surface protection against soil erosion, thus reducing the solid burden of storm waters, and decreasing the deposits of sand and silt, which are the causes of shallow and changing channels.

These two functions follow from the very nature of the forest as a soil cover. The roots of trees penetrate through the soil to the underlying rock, where they fix themselves in the crevices, and in this way hold in place the loose soil and prevent slipping and washing. The crowns of the trees break the force of the rain and also protect the soil from being carried away to the lower valleys during heavy storms. The leaves and the branches allow the rain to reach the ground but gradually; after a rain, water continues to drip from the crown for several hours, and the soil is thus enabled to absorb the greater part of it. Screened from the rays of the sun and covered with a surface mulch of fallen leaves and humus, the soil remains loose and granular in structure and is therefore capable of imbibing and retaining water with sponge-like capacity. It is strewn with fallen leaves, branches, and trunks, and traversed by a net-work of dead and live roots which impede the superficial run-off of water after heavy storm. This retardation of the superficial run-off allows more of it to sink into the ground through the many channels left in the soil by decayed roots. Surface run-off of rain water is wasteful and destructive, and unless artificially controlled serves as a rule no useful purpose and may inflict great loss. Sub-surface drainage makes the best use of the total precipitation that reaches the ground. It serves both for the sustenance of plant life and for the flow of streams. Accordingly the agency of the forest cover in increasing the seepage run-off at

the expense of the surface run-off is the most important function which the forest performs in relation to water supply.

A common conception of the effect of forest destruction upon climate is that it reduces the amount of rainfall. Because springs become dry and streams shrink in a deforested region, it is assumed that less rain must fall. Whether or not there be any truth in this assumption (I believe there is), it is certain that the main cause of the observed facts is the profound effect which forest destruction has upon the course which the water takes after it reaches the ground. The greatest influence of the forest is not upon the amount of rain which falls, but on what becomes of the rain after it falls. The water that sinks into the ground passes for greatly varying distances beneath the surface before reappearing, and is thus drawn off gradually from the forested watershed and supplies the brooks with pure water relatively free from detritus.

How active a part is played by the forest in regulating the run-off is clearly shown by actual measurements of the flow of streams which drain forested and unforested watersheds. A typical illustration of streams from barren, treeless watersheds may be found in the flow of Queen Creek, in Arizona.[1] This stream discharges only in violent freshets, recurring usually as great flood-waves which subside almost as soon as they arise. The area of the drainage basin is 143 square miles, of which 61 per cent is above an elevation of 3,000 feet. The rainfall is estimated to be about 15 inches. The maximum flood discharge of Queen Creek in 1896 was 9,000 cubic feet per second, and the mean discharge was 15 cubic feet per second; during a large portion of the year the stream was entirely dry.

Cedar Creek, in Washington, is typical of streams flowing from timbered watersheds.[2] The basin of Cedar Creek lies on the western slope of the Cascade Mountains and is covered with a dense forest and a very heavy undergrowth of ferns and moss. The drainage area is the same as that of Queen Creek, 143 square miles. The precipitation for the year 1897 was about 93 inches for the lower portion of the basin, and probably 150 inches on the mountain summits; in spite, however, of the fact that

[1] Eighteenth Annual Report of the Geological Survey, Part 4, Hydrography.
[2] Nineteenth Annual Report of Geological Survey, Part 4, Hydrography.

the precipitation in Cedar Creek basin was from six to nine times more than that in Queen Creek basin, the maximum flood discharge of Cedar Creek for 1897 was but 3,601 cubic feet per second, as against the 9,000 cubic feet of Queen Creek. On the other hand the flow of Cedar Creek was continuous throughout the year, and the minimum discharge was never less than 27 per cent of the mean for the year. The mean discharge of Cedar Creek was 1,089 cubic feet as against 15 feet for Queen Creek. This radical difference in the behavior of the two streams can be explained only by the difference in the soil cover of the two basins. Cedar Creek basin is covered with a heavy forest, while Queen Creek basin is almost entirely bare, with but a few scattering pinion trees and a little brush or grass.

Mr. Marsden Manson,[3] in discussing the stream flow from certain points on the Yuba River basin, California, makes a very interesting comparison between its two branches, North Fork and South Fork, of which the first has a forested and the second a denuded basin. Both of the catchment areas lie on the western slope of the Sierra Nevada, and have exposures of marked similarity.

The south branch of the North Fork has a watershed area of 139 square miles, which gave in 1900 a maximum run-off of 113 cubic feet per second, or 0.8 cubic feet per second per square mile. This drainage area is well covered with timber and brush, and for four months gives a minimum run-off of 1,441,125,000 cubic feet.

On the South Fork, above Lake Spaulding, there is a watershed of 120 square miles from which the scattering timber that once existed has been cut off. The run-off of this area is practically nothing for four months in each year, because of this absence of forests. If this area were afforested and gave a minimum run-off of 0.8 cubic foot per second per square mile, the discharge would be 100 cubic feet per second, or equivalent to 1,036,800,000 cubic feet of effective storage capacity. To supply water for mining and power purposes a number of costly storage reservoirs have been built on the South Fork. By reforesting the small watershed a natural reservoir would be created whose storage capacity would

[3]Features and Water Rights of Yuba River, California, Bulletin 100, Office of Experiment Stations, U. S. Department of Agriculture. 1901.

be almost equal to the storage capacity of all the reservoirs[4] above Lake Spaulding dam.

A careful study of the behavior of the streamflow on several small timbered and non-timbered catchment areas in the San Bernardino Mountains of Southern California, made by Professor Toumey for the Forest Service in 1902, brought out in a most convincing manner the effect of the forest in decreasing surface run-off and sustaining the flow of mountain streams. Three timbered drainage areas were studied. These gave during December—a month of unusually heavy precipitation—a run-off of but 5 per cent of the heavy rainfall for that month; during the following months of January, February and March, they gave a run-off of approximately 37 per cent of the total precipitation, and three months after the close of the rainy season still supported a well-sustained streamflow. At the same time, the similar and neighboring non-timbered catchment area under observation gave during December a run-off of 40 per cent of the rainfall, and during the three following months a run-off of 95 per cent. In April the run-off was less than one-third of that from each of the forested catchment areas, and in June the stream from the non-forested area was dry.

Streams flowing from barren, treeless watersheds, carry an amount of gravel, sand and soil which is simply enormous compared to the amount in streams from timbered areas. Thus the United States Geological Survey determined the amount of silt carried by the Gila River at the Buttes, a stream whose basin and regimen is similar to that of Queen Creek, of Arizona, to be 10 per cent of the volume wet or 2 per cent of solids. To appreciate these figures it must be remembered that one-fourth of one per cent of solid burden in the stream is enough to make the water turbid.

As long as the ground is protected by a natural covering of forest growth, rainfall has very little erosive action. It is only after the ground is laid bare by the removal of the forest that the erosion of the soil attains dangerous proportions.

There has, of course, always been, even when the natural forests were unimpaired, some erosion, especially in the watersheds of streams in the Southeast and Southwest, but not to the extent which now obtains, and the present erosion is not only

[4]The aggregate capacity of all the reservoirs is 1,375,000,000 cubic feet.

excessive, but is yearly increasing. It is the price, and in a large measure the product, of necessary agricultural and industrial development under defective methods of work. According to studies of Humphreys and Abbott the wearing down of the earth's surface over a region such as the Mississippi Valley is something like one foot in five thousand years, independent of human action. At such a rate of erosion the amount of sediment carried by the Mississippi River before the dawn of civilization could not be more than 70,000,000 tons per year. According to Professor Shaler the wearing down of the Mississippi Valley under complete tillage will be about the same as that of the Valley of the Po in northern Italy, or one foot in one thousand years. At such a rate of erosion, the solid burden of the Mississippi River should be 350,000,000 tons. But the amount of solid matter carried every year by the Mississippi River was estimated several years ago to be 400,000,000 tons. In other words, the erosion had then reached, if not exceeded that of the Po Valley. It is greater now. The formation of soil through underground decay of the rocks cannot keep pace with such a rate of erosion. Unless measures are taken to check it the fertile layer of soil must gradually disappear, as has happened already over large areas in the Old World from precisely similar causes.

The ruinous effects of the destruction of mountain forests upon the navigability of streams and the cultural results of human labor have long been felt by most European countries and attempts have been made to remedy them. France in particular has learned by bitter experience how terribly the lowlands suffer when the mountains lose their forest cover, and has now proved by practical demonstrations that the losses produced by forest destruction can be repaired only by reforestation.

During the French Revolution of 1789 extensive clearings were made in the forests of the Provençal Alps. The French Government early recognized the danger which such bare areas threatened to property and industry, and emphasized the importance of reforestation. In 1842 the classical investigations by Surell made it evident that forest clearing was responsible for most of the damage caused by mountain torrents, and that in reforestation lay the remedy. Laws were enacted in 1860 and 1864 which recognized that reforestation, to improve streamflow, to restore the soil, and to regulate torrents was of public utility, and therefore that

it was a duty of the government. Two methods were adopted to carry out the work. Government assistance for reforestation voluntarily undertaken by communities or private individuals; and compulsory reforestation by means of temporary dispossession, whereby the option was left with the owner of recovering his lands either by reimbursement of cost or by surrendering one-half the area to the government. The work was entrusted to the French Forest Service, and from 1861 to 1877, inclusive, an area of 233,590 acres of mountain land was put into forest or grass at a cost, including certain incidental expenses, of $2,900,000. At the close of the last century the fund appropriated by the French Government for protective afforestation amounted to $12,500,000 in round numbers, of which $4,900,000 went toward purchase of land and $7,600,000 was spent in improvement of streams and reforestation of their drainage basins. The work resulted in bringing under control a number of torrential streams and in reforesting about 425,000 acres of land, 58 per cent of which belonged to the government, 25 per cent to communities and 17 per cent to private individuals. France has now a far-reaching plan for bringing under control about 3,000 torrential streams in the Alps, Pyrenees, Ardenees, Cevenees and the central plateaus, at a cost of $40,000,000. Of this 35 per cent, or $14,000,000, is for reforestation alone.

In Austria, attention was attracted to reforestation of watersheds as a means of regulating stream flow by the great floods in the Tyrol and Kärnton. Austrian foresters enumerate over 500 torrents in the Tyrol, whose basins need reforesting, and on 100 streams the work has already begun. Similar work is being extensively carried on elsewhere among the Austrian Mountains.

In Italy the pressing need of reforesting land in the Apenines and the southern slopes of the Alps has long been urged upon the government by the people on account of the immense destruction wrought annually by the Po, which is now three times as destructive to land as it was in the past century. As a result of numerous petitions, a bill was passed in 1882, whereby waste land amounting to nearly a million acres was to be gradually reforested, involving an initial cost of $8.40 per acre beside current expenses.

The great efforts of nearly all the states of Europe to counteract the effects of indiscriminate forest clearing, efforts which involve an outlay of scores of millions of dollars, show how impor-

tant the mountain forests are. They should be regarded as a sort of capital, whose function in the national economy is far higher than the income which the timber may yield.

Forests at high altitudes, at the sources of navigable streams, on shifting sands, on banks of large rivers, and on steep exposed slopes are recognized in most of the European countries as "protective forests," and are managed with the prime object of preventing washing and erosion of soil. Thus at high altitudes on steep, exposed slopes and near the timber line, clear cutting as a rule is forbidden and timber must always be cut either in narrow strips or by gradual thinning. Severe governmental regulations controlling the management of protective forests on private lands are common in Europe. There can be little doubt that similar action will be forced upon us in the United States by the results of destroying our mountain forests.

THE INLAND WATERWAYS OF GREAT BRITAIN AND THE PLANS UNDER CONSIDERATION FOR THEIR IMPROVEMENT

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Extent of the British Inland Navigation System

The total extent of the waterways of Great Britain and Ireland, as stated in a Return of the Board of Trade, 1898, which is the latest official record on the subject, is 3,906 miles 69¼ chains, the mileage of those in England and Wales being returned as 3,167 miles 16¼ chains, that of those in Scotland 153 miles 21 chains, and that of those in Ireland 586 miles 32 chains. This estimate, however, can only be taken as approximately correct. It omits various waterways of which no official record has been preserved, such as Milford Haven, one of the finest harbors in the kingdom, which has between twenty and thirty miles of inland navigation; and it also differs considerably both from an earlier estimate of the board published in 1883 and from the estimates of various engineers who are recognized as authorities on the subject. The discrepancy between these various estimates appears to be mainly due to the omission from some of the waterways included in others and does not extend to mileage, and a comparison of their details with those given in the Board of Trade Return of 1898 shows that, after deducting 607 miles of waterway abandoned or converted into railway, the inland navigation system of the kingdom comprises about 3,793 miles in England and Wales, 341 in Scotland, and 629 in Ireland—a total of 4,764 miles. The estimates on which this conclusion is based are given in the subjoined table.[1]

[1] Of the following estimates, those of Mr. Couder, C.E., Mr. Taunton, C.E., and Mr. Lloyd, C.E., were prepared for the select committee on canals, 1883; that of Mr. Wells, C.E., for the Birmingham Conference, 1898, on Inland Navigation, organized by the Institution of Mining Engineers; and that of the late Mr. Vernon Harcourt, C.E., is contained in a paper on the subject read before the Society of Arts, 1899. To these might be added, did space permit, an estimate of the Irish waterway system contained in the report of a commission on the subject, of 1882, which gives the total extent as 708 miles, 20 chains:

Character and Development of the System

The bases of this system have in each of the three kingdoms been supplied by their numerous navigable rivers, which, owing to the neglected state of the roads after the decay of the old Roman highway system, formed the principal means of transport until the introduction of the turnpike roads. The tidal coast line of Great Britain is 3,900 miles in extent and greater than that of any other country in Europe, and, as has been pointed out by the late Mr. Vernon Harcourt, the tidal wave which traverses the British coasts places these rivers, which, owing to their small drainage areas, would otherwise be of no value for ocean navigation, on a par with the largest of those of other countries. The Thames, for instance, with a basin of 1-82 that of the Danube, affords superior facilities for navigation at high water between the sea and London to that of the Sulina mouth. The Mersey, with a basin only 1-722 that of the Mississippi, is as accessible at high tide up to Liverpool as the South Pass. The navigable channel of the Usk, the basin of which is only 1-888 that of the Volga, has nearly double the depth, at high water of fair neap tides, of the most favorable Volga outlet, and about three times the present available depth in that river from the Caspian Sea up to Astrakhan. The Ribble is of more use for navigation than the Rhone, though its basin is only 1-58 that of the latter river; and in earlier times this tidal wave penetrated much further inland and the navigation of the rivers flowing into the Wash was so good that as late as 1649 the now

	Board of Trade. Return 1883.	Mr. Couder. 1883.	Mr. Taunton. 1883 [England, Wales and Scotland only].
England and Wales	2688	4333 1878 Feeders.	2451 371 derelict.
Scotland..........	85	354	190
Ireland...........	256	755	
Total............	3029	7320	3012

	Mr. Lloyd. 1883 [England and Wales].	Mr. Wells. 1895 [England and Wales].	Mr. Vernon Harcourt. 1899.
England and Wales	3742 308 derelict.	3920 415 derelict.	3374
Scotland..........			120
Ireland...........			610
Total............	4050	4335	4106

To these estimates may be added that of Mr. Rudolph de Salis for England and Wales as given in Bradshaw's Canals and Navigable Rivers of England and Wales, where the mileage for those countries is given as 3,915 miles, 842 miles of which are tidal and 3,073 non-tidal.

insignificant port of Lynn supplied six counties wholly and three partially with imports from the continent.

Early Developments

During the seventeenth century this system of natural waterways was developed by a series of acts of Parliament empowering private individuals and bodies of individuals to improve the navigation of rivers and to make others not previously so, navigable. This movement was followed by the initiation by Brindley in 1795 of what may be termed the "canal era," during which all the navigable rivers of the kingdom were gradually connected with each other by means of a network of canals constructed by private enterprise in order to provide for the needs of different localities. In England and Wales the development of inland navigation, which began in 1423 with an act for removing obstructions in the Thames, may be said to have practically ended with the completion of the Manchester Ship Canal in 1894, and has thus extended over four and a half centuries. In Ireland it began only in 1715, with the improvement of the Maigue River, and ended with the completion of the Ballinamore Canal in 1859; and in Scotland it was limited to the eighty-eight years between the passing of the first Clyde improvement act in 1759, and the completion of the Caledonian Canal in 1847.

Varieties of Waterways

It has, however, proceeded on the same lines in each of the three kingdoms, the inland navigation systems of each of which include the three following varieties of waterway:

(1) Tidal navigable rivers, the soil of the bed of which is vested in the Crown for the benefit of the public, and on which all the subjects of the Crown enjoy the right of free navigation.

(2) Nontidal rivers which have been made navigable, and tidal rivers the navigation of which above the tideway has been improved under an act of Parliament, the ownership of the soil of which is, in both cases, for the purposes of navigation only, vested in commissioners or conservators appointed under the act who are entitled to demand tolls for the use of the river, which are devoted solely to the maintenance of the navigation.

(3) Canals constructed by private enterprise by companies

incorporated under special acts, who are the sole owners of their respective undertakings and are entitled to all the profits accruing from the tolls payable under these acts by the public for their use.

State Ownership and Control

In England and Wales state ownership of waterways is limited to the soil of the bed of tidal rivers, as above mentioned, and the state has never contributed in any way to the development of water conservancy. In both Scotland and Ireland, however, it has not only made large grants from the treasury for this purpose—the total expenditure on the Caledonian Canal in the former country, for instance, amounted to £1,280,000, and the grants for the Royal Canal of Ireland to £359,776—but is also the owner of the Caledonian Canal (constructed entirely by it) and the Crinan Canal in Scotland and of the Maigue, Boyne, Tyrone and Shannon River navigations in Ireland, where it also originally owned both the Grand and the Ulster Canals. The Board of Trade is the central authority for the control of inland navigation, and has the power of providing for the inspection of waterways, the condition of which is dangerous to the public, or liable to cause obstruction to traffic, and for their transfer to local authorities, or, if necessary, their abandonment. English canal companies are also required to send to the registrar of joint stock companies annual returns stating the address of the office and principal officers of the company; and the governing authorities of all waterways are under the obligation of furnishing the Board of Trade, when required to do so, with particulars respecting their works, capacity for traffic and capital, revenue, expenditure and profits.[2] The Caledonian and Crinan Canals in Scotland are controlled by commissioners appointed by the Crown, and those owned by the state in Ireland by the commissioners of public works in that country, and both of these bodies report annually to Parliament.

Conservancy Authorities

The governing bodies of the different waterways comprised in the British inland navigation system vary very greatly both in size and constitution, and in addition to the canal companies include bodies of conservators, commissioners, port and harbor authori-

[2]This power has been exercised by the board only twice since it was first conferred on it by the Railway and Canal Traffic Act, 1888.

ties and municipal corporations. The conservancy authorities of a few of the more important rivers are of a representative character. The conservators of the River Thames, for instance, are thirty-eight in number and include representatives of the Admiralty and two other government departments, of the city and the county of London, of the London Water Board, and of the county or borough councils of the eleven counties traversed by the river. The thirty commissioners of the Severn represent the counties of Gloucestershire and Worcestershire, and the corporations of all the towns on the banks of the river from Bristol to Wenlock in Salop, while the tidal portions of both the Mersey and the Clyde are controlled by trusts on which the municipalities of Liverpool and Glasgow are largely represented, as well as the conservators of the navigation of those rivers.

Groups of Waterways in England

The waterways of England and Wales are divisible into six groups, one of which has its center in Birmingham, while the other five unite wholly or partially in the estuaries of the Humber, Mersey, Wash, Thames and Severn. The Thames and Severn are united by 648 miles of waterway; the Thames and Humber by 537 miles; the Severn and Mersey by 832 miles and the Mersey and Humber by 680 miles, while the ten waterways flowing into the Wash have an extent of 431 miles. London is connected with Liverpool by *three* through routes, with Hull by *two* and with the Severn ports by *four;* Liverpool with the Severn ports by *two,* with Hull by *three,* with the South Staffordshire mineral districts by *two;* and the last named districts with the Severn ports by *three* routes. Though, however, *nine* of these nineteen through routes terminate in the Severn ports and *nine* in London as against *ten* in Liverpool and five in Hull, the southern waterways are now of far less importance than those of the northern counties. No less than 23,500,000 tons of 37,426,886 which according to the Board of Trade returns, 1898, was the total traffic on English and Welsh waterways in that year, was concentrated round an area bounded by the Birmingham and Shropshire Union Canals, the Leeds and Liverpool Canal, the Aire and Calder Navigation, the Don Navigation, a line from Sheffield to Stoke, and the Trent and Mersey Navigation—a mining and manufacturing district, the waterways of

which have a united length of only 642 miles. The traffic of the Birmingham canals amounts to 7,750,000 tons; that of *three* other systems of waterways within this area to between 2,000,000 and 3,000,000 tons; that of *three* to between 1,000,000 and 2,000,000 tons; and that of *seven* to between 500,000 and 1,000,000 tons. Only *three* waterways within this district have less than 100,000 tons traffic, but the Grand Junction Canal is the only waterway extending into the southern counties which has a traffic exceeding 1,000,000 tons, and only *three* (the Stafford and Worcester Canal, the River Lea and the Thames between Oxford and London) have a traffic exceeding 500,000 tons.

Scottish Waterways

In Scotland, though the Tay—navigable for 95 miles up to Perth for vessels of 200 tons—the Tweed and the Dee have been utilized for purposes of navigation, the Clyde and the Forth are the only two navigable rivers of importance. The country possesses only five canals, two of which, the Caledonian and the Crinan, though remarkable as engineering works, have proved of little value for purposes of trade, and in 1898, when the total traffic amounted to only 1,223,304 tons, the only waterways having a traffic exceeding 100,000 tons were the Forth and Clyde Navigation and the Edinburgh and Glasgow Union Canals. Scotland, however, possesses special advantages as regards inland navigation in the extent and number of its navigable lakes and in the fact that the firths of its two principal rivers—the Forth and the Clyde—are not separated by any range of hills and penetrate the plain between them on opposite sides, dividing the country, the breadth of which is there reduced to 50 miles, into halves.

Irish Waterways

Ireland, which, like Scotland, has numerous large navigable lakes, has an excellent system of waterways, which comprises both the longest river and one of the most extensive canals in the United Kingdom—the Shannon, 143 of the 256 miles of which are navigable, and the Grand Canal, which is 163 miles long and has ten branches. Owing, however, probably to the absence of manufacturing and mining industries in the country, the total traffic in 1898 amounted to only 708,174¼ tons, 309,288 tons of which was con-

centrated on the Grand Canal, which, with the Lagan Canal, with a traffic of 171,784 tons, are the only two on which the traffic exceeded 100,000 tons, while the Shannon, with 83,688 tons, was the only waterway on which it exceeded 50,000 tons.

Principal Rivers of the United Kingdom

The rivers of the United Kingdom with the greatest extent of navigation are the Thames, 215 miles long, which is navigable for 145 miles; the Severn, about two-thirds of the 200 miles of which are navigable; the Shannon, navigable for 143 miles out of its total length of 256 miles, and the River Forth, in Scotland, which, though only 72 miles long, is navigable for 50 miles. The short tidal navigations of the Tyne, Wear, Tees and Humber, on the east side of the Clyde, Mersey, Ribble and Bristol Avon on the west coast, though none of them much exceed 20 miles in length, are, however, of far greater importance for commercial purposes.

The Manchester Ship Canal

The most important of the British canals, both commercially and from an engineering point of view, is the Manchester Ship Canal, begun in 1885 and opened for traffic on May 21, 1895, on which £15,173,402 was expended—a total which included £1,786,-313 paid for the Bridgwater Canal and £1,214,451 for compensation paid to various bodies possessing vested interests in the land it traverses. The canal, which is 35½ miles long and from which no less than 53,000,000 cubic yards of soil were excavated,[3] consists of three sections. The first of these runs from Eastham to Runcorn, near or through the Mersey estuary, a distance of 12¾ miles, and is provided with three tidal locks with chambers 600 feet by 80 feet, 350 feet by 50 feet, and 150 feet by 30 feet, with sills 28 feet, 25 feet and 16 feet, respectively, below the normal water level of the canal. The second section runs from Runcorn to Latchford, near Warrington, 8½ miles, where it is inland, but in which the level of the water as in the first section is raised by the tides; and the third from Latchford—where the locks stop the tidal action and the canal is fed by the Mersey and Irwell up to Manchester. One of the most notable features of the work is the swing aqueduct for the Bridgwater Canal, the first of its kind,

[3]Ninety-seven excavators, eight large bucket ladder dredgers and fifty-eight steam navvies were employed on the work besides some small dredgers.

by means of which, when closed, traffic can pass along the latter canal as heretofore, but which can be opened to allow of ships crossing it on the lower level of the ship canal. This aqueduct, constructed by Sir E. Leader Williams to replace that built by Brindley 136 years previously, was the first *fixed* aqueduct constructed in the United Kingdom. It may be added that the Manchester Ship Canal is the first large ship canal constructed with locks raising vessels 60½ feet and transporting them inland.

The Caledonian Canal

Though it failed to realize the main objects for which it was constructed, the Caledonian Canal, having regard to the physical difficulties overcome in its construction and the period at which it was made, must be regarded as being scarcely less remarkable as an engineering feat than the Manchester Ship Canal. Its length is 60 miles, 37½ miles of which consist of four naturally navigable freshwater lochs connected by a series of canals 23 miles in length, and it extends diagonally across Scotland from Fort William on the Atlantic to Clachnaharry on the shore of Beauly Firth on the North Sea, and thus provides a means of enabling vessels to avoid the dangers and delays incident to the 500-mile voyage by the Orkneys and Cape Wrath. There are docks both at Corpach and Clachnaharry, the latter of which cover an area of 32 acres, and one of its most remarkable features is a series of eight connected locks, called by Telford "Neptune's Staircase," constructed to overcome the difficulty caused by the difference in the levels between Lochs Lochy and Eil, which, though the distance is only 18 miles, amounts to 90 feet. The canal is one of the finest monuments of Telford's genius, and is also notable as the only British waterway which has been constructed entirely at the cost of and has always remained under the control of the state.

The Grand Canal of Ireland

The total expenditure by the state on the Caledonian Canal was £1,300,000 and it also contributed £321,674 out of the £1,370,000 expended on the Grand Canal in Ireland, which is the most important waterway in that country, and though its total length of 163 miles is exceeded by that of the Shropshire Union, which is 200 miles long, it is, as has been said, the most extensive water-

way in the United Kingdom. It extends southwards from Dublin to New Ross in Wesford and westward to the Shannon Harbor, where the trade boats of the company tranship into steamers plying northwards to Athlone and southwards to Limerick, while on the other side of the Shannon it runs to Ballinasloe and has no less than ten branches connecting it with the Liffey and various trading centers.

Other English Canals and Their Earnings

Among other English canals the next in length to the Shropshire Union are the Grand Junction, 188 miles long; the Birmingham canals, with a united length of 158 miles, and the Leeds and Liverpool Canal, 141 miles long. The Birmingham canals had, according to the Board of Trade returns, 1898, the highest net revenue earned by British canals in that year, £119,193, as against £103,663 earned by the Manchester Ship Canal; while the third waterway on the list was the Aire and Calder Navigation, which, though only 85 miles long, had a net revenue of £92,057, as against £50,642 earned by the Leeds and Liverpool, £48,840 earned by the Grand Junction, £23,613 by the Grand Canal, Ireland, and only £1,099 by the Shropshire Union. The Aire and Calder and the Weaver are the two most remunerative of the river navigations of the country, and over 1,000,000 tons of salt, besides a considerable trade with the potteries in coal, timber, cotton, flint and clay are annually carried over the latter river, which has been canalized for 50 miles between Northwich and Chester, and has four large locks 220 feet long by 42 feet 6 inches wide, and having 15 feet of water on the sills.

Financial Position of British Waterways and Its Causes

As will be evident from the above figures, a large portion of the inland navigation system of the United Kingdom, on which £14,000,000 had been expended up to 1830, has ceased to be remunerative. No less than 39 out of the 99 waterways of England and Wales were shown by the return of 1898 to be carried on at loss, and of the 126 waterways in the United Kingdom only *two* earned net incomes exceeding £100,000. Only *twelve* waterways earned incomes between £10,000 and £100,000, and only fourteen incomes between £1,000 and £10,000. Of the remainder only *eleven*

earned incomes exceeding £500; and, though the impoverished condition of the canal companies and navigation authorities is partly due to the defective and obsolete construction of a majority of the waterways, the number of conflicting authorities by which they are governed and the keen competition between them, it is primarily attributable to the extensive control which the railway companies have acquired over the whole of the inland navigation system.

Railway Control

This control was first acquired by the railway companies at the time of the "railway mania" of 1845, when not only the public, on whose investments the canal companies depended for support, but also the companies themselves appear to have simultaneously concluded that water transport was about to be permanently superseded by the new invention. Though some of the canal companies were still paying dividends of 25, 26 and 30 per cent, many of them put pressure on the railway companies to purchase their undertakings, and by the end of 1846 the latter bodies had acquired possession of 944 miles of waterway; the ownership of nearly one-third of the waterways in England and Wales; one-fourth of those in Scotland, and more than one-sixth of those in Ireland is now divided between thirteen railway companies in England and Wales, two in Scotland, and one in Ireland. Where a railway company owns an entire canal it can regulate the traffic for the benefit of its railway, and where it owns only a portion of it, it can fetter the traffic on the other portions; and as almost every through water route has links in it under the control of a railway company, the railway companies, each of which exercises sole control over its own through route, are enabled to manipulate the traffic on the majority of waterways as they please. By charging excessive tolls, keeping their canals narrow, and making rules to fetter traders who attempt to convey their goods entirely by water, they have induced what the late Mr. Couder, R.E., termed a state of "creeping paralysis" among canal companies, the impoverished condition of which, in a majority of cases, renders it impossible for them to attempt the improvements necessary to enable them to compete with their wealthier rivals.

Defective Condition of Waterways

Owing to the neglect of inland navigation for over three-quarters of a century the greater number of canals still retain their original form of construction and are practically enlarged ditches, with a top water of about 30 feet and a bottom of 14 feet and with inclined slopes on either side—a form which produces a tendency to fill up at the bottom, with a consequent variation in the depth of the waterway in different canals, which is a serious impediment to traffic. In many cases both the locks and the canals themselves are too narrow to allow boats to pass each other properly, while throughout Great Britain, and especially in England and Wales, there are scarcely two canals that have a common gauge, and in some cases two or three different gauges of locks are to be found upon the same canal. Only 20 per cent of the independent waterways can admit craft that would enable them to realize the full value of economical transport. While there are 1,240 miles of canals designed for boats carrying cargoes of from 18 to 30 tons, and Calder and the Weaver, have been sufficiently enlarged and and 2,040 miles adapted for boats carrying cargoes of 40 to 60 tons, there are only 230 miles of waterways which, like the Aire, are improved to accommodate boats carrying from 90 to 350 tons. Some of the waterways under public trusts, and especially the more important rivers, such as the Thames, Severn, Lea, Clyde, Forth and Shannon, have been considerably improved, but the majority of these are much in the same position as those dependent upon private enterprise.

Defects of Organization and Competition

In addition to the two causes which have just been discussed, waterways have suffered from the want of enterprise and of the capacity for concerted action among canal companies, to which the railway companies largely owe their success, and from the number of conflicting authorities by which the majority of river navigations are governed. While the ownership of 22,455 miles of railway in the United Kingdom is shared between some thirty-eight companies, each of which governs its own through route, that of the 3,321 miles of waterway which remain independent of railway control is divided amongst more than double that number of canal companies and navigation trustees. Not one of the nine-

teen through routes by water in England and Wales has the advantage of being under a single body. There are, including the authorities of the navigable tideways such as the Mersey, Severn and Humber, *twenty-six* different bodies which compete with each other on the *three* through routes connecting London and Liverpool. There are *twenty-seven* on the four between London and Bristol, *ten* on the *three* between Birmingham and Bristol, and the same number on the *three* between Hull and Liverpool. The commissioners of the Severn control only 42 miles of its total length of 250 miles and the only conservancy authority on the Trent, which is 167 miles, exercises jurisdiction over only 73 miles; but the 57 miles of the Kennet and Avon are controlled by *four* different authorities, the 31 miles tidal portion of the Nen by *eight* public bodies, and the Witham, which is between 80 and 90 miles long, by *seventeen* different sets of commissioners. Water transport in the United Kingdom is, therefore, seriously impeded both by the defective administration arising from this multiplicity of authorities and also by the keen competition for traffic between the canal companies, which have hitherto entirely ignored the facilities offered to them under the Railway and Canal Traffic Act, 1888, for establishing a clearing system analogous to that which has so greatly benefited the British railway companies.

Revived Interest in Inland Navigation

The defective condition of British waterways has long been generally recognized, and during the last quarter of a century there has been a revival of public interest in the subject as well as in those of water supply, fishery and other kindred branches of water conservancy.

Inland navigation has been discussed from time to time by bodies like the Institution of Civil Engineers, the Society of Arts and the Associated Chambers of Commerce of the United Kingdom, and more especially at the meeting of the British Association at Dublin in 1878, and at conferences organized by the Society of Arts in London in 1888, and by the Institution of Mining Engineers at Birmingham in 1895. A very valuable paper, for which the Telford gold medal was awarded, was read before the Institution of Civil Engineers, in May, 1905, by M. J. A. Sauer, M. Inst. C. E., in which he advocated that main trunk canals should be constructed

for conveying cargoes of not less than 250 to 300 tons at a time for the more important cross-country routes, with locks, 230 feet by 22 feet, with 6 feet 6 inches water on the sills, and vertical lifts 13 feet by 17 feet, with 6 feet 6 inches where required. "The Improvements required in Inland Navigation," also formed the subject of a paper, by Henry Rudolph de Salis, Asso. M. Inst. C. E., read at the general meeting at London of the Institution of Mining Engineers on June 15, 1907, in which the author, who has personally inspected the whole of the inland navigations of England and Wales, urged that the primary essentials for their improvement are the selection of such as are likely to repay development, and the reorganization of the authorities controlling them. Various "canal projects," none of which, however, have yet been adopted, have been from time to time placed before the public—such as the construction of a national canal capable of accommodating steam barges to connect the Thames and the Mersey;[4] ship canals, connecting Goole and Sheffield, and between the Mersey and Birmingham;[5] a canal connecting Birmingham with the Trent and the North Sea; and an improved waterway between the Midlands and the Thames. The revived interest in waterways has also borne practical fruit in the construction of the Manchester Ship Canal, the most important event in the history of British waterways since the opening of the Bridgwater Canal—the success of which has itself tended to encourage canal enterprise. It has been evidenced by the amalgamation, in 1894, of the Berkley Ship Canal and three other inland canals[6] under the Sharpness New Rocks and Gloucester and Birmingham Navigation Company, and by a similar amalgamation in Ireland of the Ulster, Coal Island and Lagan canals under the Lagan Navigation Company. Its influence may also be traced in the purchase, about the same time, of the Grand Union of Leicester and the Northants Union canals by the Grand Junction Canal Company, and by the acquisition by that canal, by arrangement of tolls between Birmingham and London, and in the purchase, in 1895, by the Sheffield and South Yorkshire Navigation Company from the Manchester and Sheffield Railway Company,

[4]Advocated by Mr. S. Lloyd, C.E., in a pamphlet published in 1885.

[5]Connecting with the Manchester Ship Canal and the Mersey by way of the Weaver.

[6]The Worcester and Birmingham, Droitwich Junction, and Droitwich Canals.

of the Don Navigation, which connects Sheffield, Rotherham, Barnsley and Doncaster with the Trent at Keadby and the Ouse at Goole. In addition to this, public interest in the question has been shown by the passing, as early as 1882, of a resolution at the annual meeting of the Associated Chambers of Commerce advocating the entire emancipation of canals from the control of railway companies, and during recent years by a series of such resolutions passed both by individual chambers and by the Associated Chambers of Commerce of the United Kingdom in favor of the nationalization of waterways.

Associated Chambers of Commerce and Nationalization of Waterways

The most important resolution on the latter subject was one passed at the annual meeting of the Associated Chambers at Manchester on December 4, 1904, that:—"in view of the urgent necessity of cheapening the cost of the internal transit of goods," and of the benefit to the community that must accrue from the development of inland navigation, "this association, being of opinion that the best results can only be obtained through unity of management, strongly urges that the waterways of the United Kingdom should be acquired by the state or by a suitably constituted national trust." This resolution, which was submitted by the Liverpool and Manchester chambers—both of which had in 1882 declined to sign the resolution in favor of emancipating canals from railway control—was subsequently modified by the addition that there should be a "government guarantee, supervision and control of any national trust constituted for the purpose, and in this form was supported by sixty-one and opposed by forty of the Chambers represented, but was rendered ineffective by the fact that a two-thirds majority had not been obtained in its favor. As, however, the association had similarly advocated the compulsory purchase of canals by the government at five of its meetings, and resolutions to this effect have been since 1904 passed by various provincial chambers and discussed by the London Chamber of Commerce, it is evident that there is a substantial body of public opinion in favor of the suggestion.

The Canal Trusts Bill, 1905

The principle of the second portion of the Manchester resolution was subsequently embodied in the Canal Trusts Bill, 1905, which was introduced into Parliament by Mr. Rowland H. Bowan, the Liberal member for North Leeds, for the establishment of a canal trust "to acquire, develop, and extend and administer in the public interest canals and navigations in England and Wales. This measure, which was supported by thirteen members, belonging to the three political parties in the House of Commons and representing constituencies in the northern and midland counties, Scotland and Ireland, proposed to incorporate a body of twenty-nine trustees, twenty-one of whom were to be appointed by the treasury and other government departments, and the remaining eight by various port authorities, Chambers of Commerce and other kindred associations. This body was to be empowered to purchase the Birmingham and twelve other canals and two river navigations for the purpose of organizing a through system of communication between London, Liverpool, Hull and Bristol, and also subsequently to acquire other canals and navigations by agreement or by a provisional order from the Board of Trade. Owing, however, to the neglect of its promoters to comply with the regulation requiring bills of this description to be advertised in the London *Gazette* this measure had to be withdrawn before Parliament had had the opportunity of pronouncing an opinion upon it.

The Respective Merits of "Nationalization" and "Canal Trusts"

"Nationalization" and "Canal Trusts" may be said to be the only two schemes for the improvement of British waterways which at present find favor with the public. The first, though theoretically attractive, is open to the objections that it is likely to be opposed by the more prosperous canal companies, and, which is more important, that Parliament is not likely to be favorably disposed to a plan entailing a very heavy expenditure for the acquisition of waterways, the capacity of which for yielding a revenue sufficient for their upkeep is, to say the least, extremely problematical. Canal trusts are also, no doubt, likely to be opposed on the grounds that they interfere with the rights of private enterprise and necessitate the grant of public money for an uncertain object; but they

have the merits of providing for the transfer of the control of our waterways from a number of competing bodies to a representative central authority, and of being organizations capable of tentative introduction and gradual extension.

Extension of the Powers of the Board of Trade

In default of the adoption of either of these schemes, much might be effected in the improvement of British inland navigation by an extension of the supervisory powers of the Board of Trade, which is the central authority for waterways, if canal companies and navigation authorities would adopt the principle of co-operation in lieu of that of competition, and like the railway companies, endeavor to fit their respective undertakings for through traffic by the establishment of a minimum gauge for waterways and locks and of standard traffic rates. It must, however, be added that, as has been pointed out by the present writer and his co-author Mr. Ashford in their recently published work on British waterways,[7] the question of the improvement of inland navigation is intimately bound up with that of water supply. Canal companies and water companies now compete with each other for sources of supply, and it has been recently demonstrated both by the Salmon Fisheries Commission, 1902, and the Sewage Disposal Commission, 1898, in their third report, issued in 1903, that the indiscriminate selection of their sources of water supply by companies and municipalities and the reckless waste of water through mining operations have seriously diminished the volume of rivers and dried up many of the springs and wells which furnish rural water supply and feed canals. The two above commissions have agreed in recommending the establishment of a central water authority for dealing with this question, as well as for controlling fisheries and checking pollution, and it is one which cannot safely be neglected in any scheme which would tend to increase the demands upon the national sources of supply in order to extend the inland navigation system. All these points have doubtless been fully considered by the Royal Commission on Canals, which is now sitting, and the report of which is expected shortly to be issued. The appointment of that body is itself the most recent and also one of the most

[7]Our Waterways, by Urquhart A. Forbes and W. H. R. Ashford. London: John Murray, 1906.

important evidences of the revival of public interest in British waterways, and until its recommendations have been made public all plans for their improvement must be regarded as purely speculative. It will be evident from the foregoing necessarily imperfect sketch of some of the main features of the inland navigation system of the United Kingdom that it at all events possesses possibilities sufficient to render such an improvement eminently desirable.

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THE PRESENT SIGNIFICANCE OF GERMAN INLAND WATERWAYS[1]

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A clear comprehension of the present importance of inland waterways is only possible when the different kinds are clearly distinguished from one another. In the following pages the service intended for sea-going ships including waterways for joining the two seas, such as the Suez Canal and the North Sea Canal, will not be considered. The lower courses of large rivers made navigable for ocean steamers, such as the Elbe from Hamburg down, and the Weser from Bremen to the sea, will not be treated, as is also the case with entirely artificial canals which make inland towns accessible to ocean ships, such as the Manchester Ship Canal. That these artificial and improved shipping routes can compete in the age of railroads and play an important economic part if technical conditions are favorable, is at the present time beyond dispute.

In this paper only those inland waterways are considered which are navigable by river boats and not primarily for sea-going steamships. At present the two kinds of inland waterways are gradually blending. For instance, the Rhine from Cologne down is available primarily for river boats, and for that reason it is here included, although smaller sea-going vessels run from Cologne to England, and likewise to Hamburg, Bremen and the Baltic ports. Waterways primarily adapted for rafting timber and suitable only in a small degree for boat traffic are not considered in this article.

Most inland waterways which are used entirely or mainly by river boats are divided into two classes: natural and artificial.

[1]This study is an adaptation and translation of the fifth chapter of "Verkehrsentwickelung in Deutschland, 1800-1900," and is here reproduced by permission of the author, and the publisher, B. G. Teubner, Leipzig, 1906.

The natural include inland lakes like Lake of Constance and the great North American lakes, also rivers even when "regulated" by shortening the windings, dredging the channels to uniform depths, narrowing the banks, and by other constructions at large expense for the benefit of navigation or the adjacent lands. As artificial are considered those waterways that carry traffic over watersheds to connect different natural routes, such as the Ludwigs-Donau-Main-Canal, and the Erie Canal connecting the Hudson River and the Great Lakes; and paralleling canals dug along the course of a river not suitable for traffic to obtain a navigable waterway, as for example, many of the French canals and parts of the German Dortmund-Ems Canal. It may be questioned whether canalized rivers, that are made navigable through dams, are to be classified as natural or artificial. To this division belongs the Main between Offenbach and Mainz.

Inland Waterways at the Advent of the Railroads

The general opinion between 1840 and 1870 was strongly against the ability of inland waterways to carry traffic in competition with the railroads. Let us consider the conditions at the time of the introduction of the railroad. France, the Netherlands, Sweden and upper Italy were already served by a passable net-work of navigable channels; England and the United States had recently sought to construct what these other countries had before provided. It soon became the common belief, especially in England and America, that canals of the old type were less capable of carrying the traffic than the railroads. This unfavorable opinion gradually changed after 1875 in favor of the inland waterways. Such was the case, especially in Germany, where a notable development in traffic capacity of the inland waterways occurred in the period 1875-1905. However, by no means, were all interests glad to see the revival of inland water transportation facilities. The warmest advocates of the new development were those who were dissatisfied with the results of the control of the railroads by the state. Legislative control of tariffs, which had been hoped for at the time the railroads were taken over, has not been realized. The natural monopoly present in the railroad system has been managed by the

administration to the best of its knowledge and understanding, but in spite of this it cannot be denied that in Prussia large profits have been sought, while in Germany as a whole, since 1879, so far as the fiscal point of view has not ruled, the management has been used to favor the export of certain wares and to hinder that of others in furthering the protective tariff policy.

Many of those who were not satisfied with the official administration of the railroad monopoly, including those opposed to the commercial policy followed since 1879, and also many of its adherents, were glad to find in inland navigation a means of moving freight which was independent of the railroad administration. Those who have given a non-partisan attention to the development and traffic-carrying ability of the waterways have been forced, especially in view of the accomplishments between 1875 and 1905, to admit the increased importance of this means of transportation.

Causes of Growth of Water Transportation

On what causes does this advance depend? One important reason for the development of inland water transportation in the second half of the nineteenth century is the freedom from tolls of navigation on natural waterways. River transportation has increased in proportion with the success of the continual movement carried on between 1815-1870 for the elimination of the mediæval tolls on the rivers. Traffic was hindered and made more expensive through centuries by these tolls in return for which no important improvements in the navigability of the rivers were made up to 1800. These hindrances to the natural development of traffic on the more important German rivers were broken down by interstate agreements. The prejudices of the German people against navigation tolls were so great that they finally found expression in a rather radical form in the imperial constitution. It is true the statement is not so clear in form as might have been wished, so that to-day doubts may be expressed as to the meaning of the various clauses.

Article 54, section four, of the German Imperial Constitution reads: "Taxes may be levied on boats on natural waterways only for the use of special facilities intended for aiding traffic. These

tolls, as also those for the passage of such artificial waterways as are the property of the state, may not exceed the amount necessary to meet the costs of administration, and maintenance of the facilities where they are levied. These conditions also apply to all floating timber traffic so far as such traffic is upon the navigable waterways."

The meaning of these clauses is by no means beyond dispute. It is clear that the payment of the interest on the outlay for natural and artificial waterways was not expressly designated. Unfortunately, however, it is not stated how the tolls for meeting the costs of the improvements are to be determined, nor what is to be considered a natural and an artificial waterway. It remains uncertain whether canalized rivers belong to artificial waterways as concerns the levying of tolls. It is fairly clear that rivers not canalized by the use of dams but "regulated," and upon which large sums have been spent for the improvement of navigation are to be considered as natural waterways by these clauses of the Imperial Constitution.

The second cause of the advance of inland water transportation in Germany is a technical one. Inland navigation has received a great advantage in competition with the railroads through improvements in the control of streams, in the building of canals, in boat building, and in the methods of handling traffic. First of all, great advances have been made in rendering rivers navigable. In the first half of the nineteenth century experience proved the practicability of maintaining a minimum depth of water in rivers otherwise not navigable by means of the movable dam.[2] For the "regulation" of rivers, in which great technical advance is being made, and for the canalization of rivers increasing appropriations are being made from public funds.

One conclusion in regard to the building of artificial waterways has become apparent since 1870, viz., a canal on which only small boats drawn by horses can be moved is capable of competition with the railroads only under very exceptional conditions. The fixed costs of such a canal can, under present conditions, seldom be

[2]These are dams regulating the retention and flow of water according to the local needs. Single sections may be taken out of the dam or replaced. The dam can be made complete by the insertion of all sections or entirely removed by taking out the various sections. Such dams work perfectly on the canalized section of the Main between Frankfort and Mainz.

covered by the income from the usual canal tolls or by increased ability of the surrounding district to pay higher rates. On the other hand canals upon which heavy shipping is possible in boats of 450 to 600 tons capacity, and upon which mechanical power can be introduced for the movement of boats, do not fall under this unfavorable criticism, even in this age of railroads. It is of great importance that heavy traffic should be possible and that rapid forwarding should not be interfered with through many small locks.

Where difficulties of elevation are to be overcome, the new development in canal technique aims to overcome the differences as much as possible by a single lifting instead of through several small locks—the so-called flights of locks. The technical advances of the present day make it possible to overcome at one time by means of chamber locks differences in height of ten meters.

Another means in use at the present time to overcome the great difficulties of lockage is the use of a contrivance to raise ships floating in a chamber filled with water. This elevator method is used in the Dortmund Ems Canal in Henrichenburg, but the newer plan to raise ships on an inclined plane has proved successful as yet only for small boats. Its adaptability for use in heavy traffic is still a matter of dispute.[3]

An important improvement in river and canal transportation in the nineteenth century has come through increase in the size of the boats. The largest boat on the Rhine at the present time has a tonnage capacity above 2,600. In 1902 began the building of iron sailing and tow boats for the Rhine with a capacity of more than 650 tons. The average capacity of the sail and tow boats rose from 182 tons in 1884 to 340 tons in 1902.[4] A Rhine boat of 1,500 tons capacity can carry as much as 150 railroad cars of ten tons burden. It replaces several freight trains, and while in the last half of the nineteenth century the Ludwigs-Donan-Main Canal was built for ships with a capacity of 127 tons, the present projects for canal building provide a waterway to accommodate boats of 600 tons burden.

[3]At Elbing on the Overland Canal, boats of fifty tons capacity are carried on cars, overcoming a fall of twenty-five meters. This is not possible for boats of 600 tons.

[4]See Volume 102 of the publications of the Verein für Sozialpolitik, pp. 89-90.

Great improvements have also been made in the nineteenth century in the traction of boats on inland waterways. Besides the improvements offered by the use of chains for ascending certain rivers, the most important advance has been in the adaptation of steam power.[5] At the present time attempts are being made to adapt electricity to the propelling of boats on inland waterways, and the development of methods of mechanical towage on canals by electrical locomotives, etc., is being actively pushed.

Comparison of Present Rail and Water Traffic

At the present time inland water transportation, even in competition with the railroads, shows a much healthier development than was shown in 1800 in the competition with ordinary roads. This is true with a single qualification. The increase of inland navigation occurs primarily where heavy traffic with the adaptation of mechanical methods of towing or propulsion is possible.

The following remarkable figures showing the advance of German inland water navigation are taken from the work of Geh. Rat Sympher. These statistics give a comparison of the development of traffic on the railroads and inland waterways of Germany since 1875. The incompleteness of official statistics of inland water traffic necessitates estimates for the ton kilometer traffic passing on inland waterways, but these estimates have been made with care.[6] Of course errors are not impossible wherever estimates are relied upon. The statistics in regard to railroads, however, are more reliable. It is further to be noted that there are included 10,000 kilometers of navigable inland waterways in 1875 as well as in 1905; and in 1905 the unimportant navigable sections of the waterways are not included. In this way the showing for the traffic on the waterways in 1905 is more favorable than would have been the case had those portions carrying very little traffic been included in the average. The following figures are offered with these explanations:

[5]The use of steamboats on canals is a much more difficult problem than upon rivers. Screw propellers and sidewheelers damage the canal banks, while no such disadvantages attend their use on rivers.

[6]See as to the method used for the estimates, Zeitschrift für Bauwesen, 1891, p. 45.

German Navigable Waterways, not including River Mouths Navigable by Sea-Going Ships.

	1875.	*1905.*
Length	10,000 km.	10,000 km.
Arrived, tons	11,000,000	56,400,000
Departed, tons	9,800,000	47,000,000
Net ton kilometers[7]	2,900,000,000	15,000,000,000
Kilometric traffic[8]	290,000	1,500,000
Average distance transported	280 km.	290 km.

German Railroads

	1875	*1905*
Length	26,500 km.	54,400 km.
Ton kilometers	10,900,000,000	44,600,000,000
Kilometric traffic	410,000	820,000
Average distance transported	125 km.	151 km.
Per cent of total traffic:		
Inland waterways	21%	25%
Railroads	79%	75%
	100%	100%

If it be correct to assume that the length of the navigable waterways remains the same in 1905 as it was in 1875—ten thousand kilometers—the part of waterway traffic in the total traffic (24 as compared with 21 per cent) has increased more than the per cent of the rail tonnage, although the railways rose from 26,500 to 54,400 kilometers in length.[9]

[7]There are three ways in which the statistics of traffic may be presented: The first possibility is to ask how many tons have passed on a certain route. The second, to consider the weight and distance carried, thus arriving at a ton kilometer basis, viz., determining how often one ton has been moved one kilometer on a route. The third possibility is to determine the kilometric traffic. The whole number of kilometric tons is divided by the length of the route, and it is found what part of the entire traffic carried falls upon the average kilometer. This is the best method of comparison where we are interested in what the waterway and railroads actually accomplish for traffic. The above figures from Sympher are to be found in the Zeitschrift für Binnenschiffahrt, 1907, p. 496, *et seq.*

[8]In reckoning average distance transported it is sought to answer the following question: How many kilometers on the average does a ton of freight, once delivered to the waterway or railroad, travel before it reaches its destination?

[9]If the length of German waterways in 1900 be taken as the same as in 1875, their character was markedly improved. Major Kurs, however, reckons the length of the navigable canals and rivers in Germany in 1894 as greater than that given by Sympher, namely 12,223.02 kilometers. Including the navigable inland seas and harbors, etc., Major Kurs counts 14,939.37 kilometers in Germany. See page 10 of the Tabulated Report Concerning the Navigable Waterways and the Waterways for Rafting Timber in the German Empire. (Major Kurs, Berlin, 1894.)

Kilometric traffic was, if Sympher's estimates are to be trusted, much smaller by water in 1875 than upon the railroads. In 1905 the average traffic on railroads had risen greatly, but that upon the waterways had increased even more so that it (1,500,000 ton kilometers) exceeded the kilometric traffic of the railroads (820,000 ton kilometers). The kilometric traffic of the German waterways at the present time is greater than that upon the French waterways.[10]

These figures are indeed remarkable. However, a warning must be given that careless conclusions must not be drawn from these estimates. In the first place, in the statistics presented, only a part of the traffic carried by the railroad is compared with practically the total of that by waterways. Passenger traffic, which plays a large part in the case of the railroads, plays a very unimportant one on the water routes; but even in the case of freight traffic we must be careful not to overestimate the importance of these figures however great that may be. Though the average carriage in Germany per kilometer on the waterways in 1900 was greater than on the railroads, nevertheless we must not conclude that more freight was actually forwarded on these routes. That is not the case. The total amount of freight forwarded is in fact very much less on waterways than on the railroads.

If a fourth of the total traffic in ton kilometers is carried on the inland waterways and three-fourths on the railroads, this does not mean that one-fourth of the freight went on the waterways instead of on the railroads. About 16.2 per cent of all freight arrivals used waterways; but the once-loaded freight used the waterways on an average of 290 kilometers, and, in the case of the railroad, only 151 kilometers; therefore, in waterway traffic the figures for ton kilometers become especially large.

The distance from the shipping point to the destination does not always indicate the actual service rendered by water. Roundabout routes are necessitated by the course of the streams. Besides that, the cheapnesss of the waterway oftentimes justifies a great diversion from the direct route; thus greatly increasing the kilometer tons but not equaling the higher charges levied by the railroads. A remarkable example of this may be cited. In 1891 a large quantity of soda was to be sent from the Würtemberg

[10]The kilometric traffic on the French inland waterways is given by Sympher for 1905 as 411,000, as compared to 182,000 in 1875.

town of Heilbron to Tetschen in Bohemia. The railroad route was evidently the shortest but the soda was not sent thus, but was sent down the Neckar, then laden into a Rhine boat, again transshipped at Rotterdam and brought to Hamburg, where, after another reloading, it was taken up the Elbe to Tetschen. In spite of all this the freight charges were cheaper than upon the railroad. Further, the development of inland water traffic in Germany in the period 1875-1905 must not be believed to be the same on all routes. The greater proportion of the total inland water traffic in 1905 took place upon the Rhine and Elbe which carried 66.9 per cent of the entire amount. Great advances have been made upon the Oder and Weser, and also to a lesser degree on the Donau. Besides these instances the only advances made were upon those few canals and canalized routes which by 1905 had been made accessible for larger boats. On those waterways where no adaptation to present-day needs has been made a falling off in traffic is shown, even in this late period.

In comparison to railroad lines traversing the same territory, river navigation is able to compete best where transportation of heavy articles of low value not requiring great speed is demanded. Besides this it happens also that non-perishable articles of high value seek the waterways whenever the railroads for any reason demand high freight rates. This happens not only in the case of grain but for a large number of other articles, not included in the cheap special tariffs Nos. 2 and 3.

The Question of Tolls on the Waterways

The requirements in the Imperial Constitution on the levying of tolls on the waterways have already been presented. It remains to review the actual administration of these provisions and to describe the movement in favor of a change therein. At the present time, in practice, navigation on the open streams, with a few exceptions, is free, while the use of harbors and unloading facilities is often conditioned upon the payment of tolls. On the more important streams the freedom from taxes for the bare use of the waterways is guaranteed not only by the Imperial Constitution but by interstate agreements. On the other hand, the Prussian government levies important tolls on the canalized rivers when opportunity offers, as, for example, on the canals of the lower Main

and on the Fulda between Kassel and Münden, on the upper Oder, etc. Navigation taxes are regularly levied in Germany on the canals even for bare passage. It often happens that navigable waterways not suitable for heavy traffic, such as the Ludwigs-Donau-Main Canal, at the present time, do not pay the cost of maintenance, in spite of high tolls, since the traffic is too small. This is not always the case, however, even on the smaller canals. The waterways near Berlin, although not satisfying in all particulars the demands of present-day heavy traffic, are in much more favorable condition due to the lively business carried on upon them.

The Prussian Minister of Finance reported to the Landtag as follows: "The Finow Canal brings in an income of ten million marks, though it certainly has cost us less than two million marks. The other waterways near Berlin also bring us in a good surplus."[11]

The expenses for inland waterways in Prussia for the period 1881-1897 are given as 398,781,000 marks. Of this amount one-third was for current expenses, maintenance, administration and collection of tolls, and two-thirds for repairs, betterments and extensions. Of the total expenditures between 1891 and 1897, one hundred and forty-nine million marks were upon rivers, and 57,000,000 on the canals.[12] It is disputed whether the expenditures on waterways should be recovered by taxes upon the traffic passing over them, as in the case of railroads. It is urged, on the one side, that the costs must be covered by tolls on shipping, as otherwise one district gets a special advantage from appropriations of state funds. It is argued also that the improvement of the waterways can be carried on only when an income from shipping is secured. Taxes, in return for which something is given, are not to be compared to the old river tolls for which little or nothing was accomplished for traffic. Finally, there are strong advocates for the levying of tolls on inland water transportation (by amendments to the constitution, and the interstate agreements), in order that the Prussian railroads may not suffer an unwelcome competition which partly nullifies the tariff policy favored by those administering them. For the other side

[11]See Schwabe, p. 75. Up to the present time the Finow Canal is available only for boats of 150 to 170 tons burden. Schwabe, p. 130; also Peters, "The Financial Development of the Prussian Waterways." (Archiv für Eisenbahnwesen, 1902, p. 749.)

[12]See Schwabe, p. 125.

it is argued that waterways, like the highways on land, should be kept tax free, so that it may be possible to have free traffic by various competing lines. The expenses for improvements may well be covered through increased ability to bear taxation in the districts of land improved by them. Furthermore, the railroad is not an end in itself. When the railroads were taken over by the state it was not the intent to seek after the highest profits possible and to crush every competition that should lessen such profits. Waterways stimulate new branches of traffic, and the railroad traffic itself increases where there is a waterway capable of supplying the needs of commerce. Finally, it is not technically possible to divide the expenses of river improvements between the shipping interests and those of the neighboring districts of land.

My personal belief is that to introduce tolls upon the Rhine and Elbe navigation would be a great step backward for Germany. It is more than apparent that taxes upon river traffic in the end result in a raising of freight rates. To introduce consciously such a thing in the presence of the competition ruling in the world to-day, would be a decided step backward in our policy. Its harm would not be confined to those producing and consuming districts near the waterways.

Inland navigation facilities increase the prosperity of our sea trade. Harbors which lack inland waterways traffic command a too narrow *Hinterland* for a large foreign trade, no matter how well developed may be their railway net. The French to-day point to the prosperity of Antwerp, Rotterdam and Hamburg, and argue that they who wish a great sea trade must supplement their other facilities with a suitable inland waterways system. It is not intended to argue that tolls on canals or to cover the expenditures for large improvements on canalized rivers are objectionable in every case. Improvements that bring important traffic economies may be paid for by a reasonable tax, and within the bounds provided by the Imperial Constitution. For building canals, for the cost of which no tolls are to be levied, funds cannot be gotten from the governments and legislatures without great difficulty. In less degree the same is true of the expensive canalization of river courses.

To sum up, even in countries owning the railroads, so long as it is impossible through legislative regulation of the tariff to control the actual management of the railroad monopoly, the pos-

sibility is at hand that the railroad policy may overlook and harm important national interests. The significance of inland waterways, over which no tariff policy can acquire easy control, lies at present chiefly in the fact that they make possible free competition against the railroad monopoly. They can sooner force the railroads, through competition, to give better rates than can be the case through other methods of procedure. Nationalized railroads may be managed to favor protective tariff policies. Freedom of traffic upon waterways prevents such a development.

The advantages of inland waterways are:

1. They can carry bulk freight of non-perishable variety long distances by water cheaper than these commodities can be forwarded by railroad.

2. Traffic facilities are here offered which are independent of any economic policy favored by the management of the railroads. All freight may be carried with charges dependent solely upon the actual cost of the service.

This estimation of the importance of inland waterways at the present time does not lead to the conclusion that all projects for canals which are presented, whether technically or financially sound or not, should be favored; but, on the other hand, this investigation proves that a plan for improving inland waterways, technically and financially sound, should not be opposed merely because of the fear of the competition such facilities would bring to the traffic on other transportation means. Never in history have the agriculture and industry of a people declined because good methods of transportation were furnished through the country, but the downfall of many peoples, not only in trade and industry, but also in agriculture, has come when they neglected to maintain the great lines of communication used by international commerce.

The Prussian Law of April 1, 1905, for the Maintenance and Extension of Waterways

After the first plan of the Prussian government for joining the Rhine and the Elbe by an inland canal had been frustrated by the Prussian Landtag, a new proposition was finally passed as a compromise on the first of April, 1905. By this law 334,575,-000 marks are granted to build a canal from the Rhine to Hanover and Linden. Various enlargements are provided including a deep

waterway from Berlin to Stettin and other improvements, chiefly connected with the Oder. There is a provision that the users of the canal shall pay tolls and that the provinces and other public organizations through which the canals pass, such as Bremen, shall contribute to the interest and sinking fund on the capital raised for the projects in so far as these charges may not be met through the tolls on shipping.

A rather broad right of expropriation is reserved to the state. A waterways council is to be created from representatives of the government, of other organizations involved, and of the provinces guaranteeing for interest. Besides the decision to substitute for the Rhine and Elbe Canal a system reaching from the Rhine to the Weser and Hannover, the law introduced two other important modifications.

Paragraph eighteen reads: "Only the towage provided by the government can be used on the canals from the Rhine to the Weser and the branch to Hannover, and on the branch canals of those waterways. The establishment of mechanical towage on these routes is forbidden to private individuals. The movement of ships with their own propelling force over these routes is to be permitted only under a special license. Further provisions concerning the towing monopoly and the furnishing of the necessary capital are to be provided by a special law."

Paragraph nineteen reads: "Shipping tolls are to be levied on the rivers 'regulated' in the interests of navigation. These tolls are to be so adjusted that their yield shall make possible a reasonable interest payment and sinking fund on the capital which the state shall raise for the bettering or deepening of each of those rivers, in the interest of navigation, above their natural depths."

It remains to be seen whether, at the completion of this canal, its extension to the Elbe will be provided for; whether the interstate treaties and provisions of the constitution which have forbidden thus far the raising of tolls on navigation on free streams will be changed; whether, finally, the state towing monopoly on the Rhine and Hanover Canal will actually be established. If the intentions of the legislators of 1905 are realized in these particulars, it is evident that a development of freight traffic which will counteract the Prussian railroad tariff policy will be impossible on the inland waterways. If the railroad tariff policy remains protective and friendly to the syndicates, it will, under the above conditions,

find no true correction through the operation of the canals. Likewise, the inland waterway system will gradually cease to be a competitor against the railroad monopoly through the fact that the same interests which control the latter in favor of the protective tariff will dominate the former also for the same end.

Apropos of this estimate of the canal law the table on page 260 is significant.

It is further to be noticed that carrying through this plan that each river should bear the cost of the improvements made upon it would be especially burdensome to the Mosel, Weser, Weichsel, Memel and Warthe rivers. Upon these the traffic would, beyond doubt, fall off and their yield in tolls would be disappointing. If an eastern and western canal net were joined, all being subject to tolls under the canal law, the eastern division, including the streams at the present time free, would be seriously handicapped. The plan to make the streams bear the burden of all expenditures formerly made upon them is against all justice. The government should, as it has done in the past, assign a part of these expenses *à fonds perdu* as their benefits accrue largely to interests other than those of navigation. Future expenditures also, which work toward the cheapening of transportation, need not be met by special levies, but can be paid through the general increased ability to bear taxation.

At the present time the Prussian government is earnestly working to get the support of interested factions for a project establishing tolls on river navigation. What the result will be cannot yet be stated. Formerly the argument of the interests of the state railroads and that concerning protection against the import of cheap grains were prominent in this connection, but recently the argument has been emphasized that expenditures for the bettering of waterways should be paid by the waterways themselves, and an extensive program has been mapped out under this plan.

In this way the navigation interests have been divided into two camps: Those which are burdened with tolls at the present time are played off against those interests using the tax-free streams. To the first class the hope is held out that in the future the tolls upon them will be lessened if the heretofore free streams are compelled to contribute to the canal funds. All this is in the future.

Statement of the Amount of Tolls that must be raised on the more important River Courses to give a yield, above current Maintenance and Administration Charges, of 3½ per cent for Interest Payments on the Capital Invested and of a Contribution to a Sinking Fund.

1 Waterway.	2 Cost of construction and "regulating," 1866–1897-8, with a reduction of 50% due to expenses other than in the interest of navigation.	3 Expenditure for interest (3½%) and sinking fund on the improvements due to shipping.	4 Cost of maintenance and administration.	5 Total yearly expenditures	6 Income from tolls on traffic 1897-8. (The dues for use of safe harbors and other navigation facilities included.)	7 Yearly deficit.	8 Million kilometer tons carried.	9 Toll on each kilometric ton necessary to cover the deficit.
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*		*Pfennig.*
1. Rhine	17,000,000	595,000	1,235,000	1,830,000	142,000	1,688,000	4,045	0.04
2. Mosel	1,250,000	44,000	214,000	258,000	....	258,000	6	4.3
3. Weser, down to Bremen	4,180,000	146,000	537,000	683,000	15,000	668,000	109	0.6
4. Elbe, down to the mouth	11,015,000	386,000	1,514,000	1,900,000	95,000	1,805,000	2,475	0.07
5. Oder, down to Schwedt, except the canal division	11,790,000	413,000	1,560,000	1,973,000	125,000	1,848,000	751	0.2
6. Warthe	3,150,000	110,000	542,000	652,000	5,000	647,000	88	0.7
7. Weichsel and Nogat	10,990,000	385,000	1,991,000	2,376,000	37,000	2,339,000	175	1.3
8. Memel	6,310,000	221,000	312,000	533,000	....	533,000	112	0.5
Total	65,685,000	2,300,000	7,905,000	10,205,000	419,000	9,786,000	7,761	0.13

One great scruple is that the height of the navigation tolls are to be set by the administration and not through laws; at all events, immoderate tolls will yield nothing, as the inland transportation interests will be ruined. It is expected that the administration would be inclined to grant lighter tolls than the legislature and that they would be more independent of selfish interests. It is still to be proved whether these expectations are justified.

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BOOK DEPARTMENT

NOTES

Aimes, H. H. S. *A History of Slavery in Cuba*, 1511, 1868. Pp. xi, 298. New York: G. P. Putnam's Sons, 1907.
Reserved for later notice.

Aucuy, Marc. *Les Systèmes Socialistes d'Exchange.* Pp. vii, 372. Price, 3 fr. Paris: Félix Alcan, 1908.

The second volume in Alcan's library of Individualism and Socialism is a critical study of socialist systems of exchange. M. Aucuy undertakes to show that socialism of exchange is impossible without socialism of production, and with this in view examines, in both their theoretical and their practical aspects, the systems of Owen and Proudhon, the less known ideas of Vidal and Haeck, and the *comptabilisme social* of the Belgian Salvoy. The main interest of the book for most readers lies in the careful exposition of the ideas of the last three writers; for the thesis of the work is, of course, not new, dating back to Karl Marx. It is none the less worth while to examine the theories of these "socialists in spite of themselves," as Professor Deschamps calls them in the introduction to the book, in order to point out the fallacy of thinking that economic injustice can be done away with by merely tinkering the system of exchange without changing production. Men have always tried to find the source of their economic troubles in the working of the money system, instead of tracing the injustices of our present distribution to their roots in the system of production. M. Aucuy's book is a justified protest against this sort of thinking.

Barnard, J. Lynn. *Factory Legislation in Pennsylvania: Its History and Administration.* Pp. xi, 178. Price, $1.50. Philadelphia: University of Pennsylvania, 1907. John C. Winston Co., Selling Agents.

Under this title, the author has given a much needed and scholarly account of this field of social progress in Pennsylvania. The subject matter is divided almost evenly into the two fields of History and Administration. Under the former, the movement for the legal regulation of women and child labor is carefully reviewed from the days of 1824 until the present date. Allied movements, such as sweatshop, fire-escape and bake-shop legislation are duly treated. Particular emphasis is thrown on the gravity of the child-labor situation in Pennsylvania and the work of certain public-spirited organizations and citizens since 1904 in attempting to ameliorate these conditions.

Under the subject of Administration, the author shows an inside knowledge of the conditions which make easy the violation of the factory law. Here, again, he shows how far short of even an imperfect standard we have fallen in regard to caring for our future citizens—the children. Dr.

Barnard, from his actual experience in child-labor legislation and from his valuable experience as a teacher, is in a position to point out a way to higher things.

Books such as this, covering all the large industrial states, would soon remove the criticism one sometimes hears that college courses in social welfare would be very good were they not "spread out so thin."

Barnett, G. E. *A Trial Bibliography of American Trade Union Publications.* Pp. 139. Baltimore: Johns Hopkins Press. 1907.

Bazaine, M. *La Intervencion Francesa en Mexico.* Pp. 283. Price 75 cents. Mexico: G. Garcia. 1907.

Beazley, C. R. *Dawn of Modern Geography.* Vol. III. Pp. xi, 638. Price, $6.50. New York: The Oxford University Press. 1906.

Reserved for later notice.

Berens, Lewis H. *The Digger Movement in the Days of the Commonwealth.* Pp. 259. Price, $2.00. Chicago: Public Publishing Co., 1906.

The Digger Movement,—so called because the devotees of the movement went out into the public commons and dug them up in an effort to secure crops from the land which, according to their theory, was anybody's for the using,—centered around the life and writings of Gerrard Winstanley.

Starting from a standpoint strictly religious, Winstanley worked out the theory of his digger movement. He says: "In the beginning of time, the great Creator, Reason, made the earth to be a common treasury to preserve beasts, birds, fishes and man, the Lord who was to govern this creation." Therefore, he argues, the earth belongs equally to all. When equal freedom of the land is denied to some, this is a sign that the people are not really free, but only seemingly so.

Winstanley's whole doctrine is summed up in these words—"True Commonwealth's Freedom lies in the free enjoyment of the earth."

He wrote principally during the administration of Oliver Cromwell. His movement was hindered by the government officials and the officers of the troops stationed in his neighborhood. As with all reform movements, the people for whose benefit the movement was made were the loudest in their outcries and ridicule. After working for a long time in the face of this opposition, at the digging of the commons and writing appeals to the nation, Winstanley was finally forced to desist. In his work we have perhaps the first definite statement of the thought that the returns from natural resources are given to all and should be enjoyed equally by all. This is the doctrine which, worked out along a wholly different line by Henry George, brings him to his single tax theory.

Bierly, W. R. *Police Power: State and Federal.* Pp. xxviii, 338. Price, $3.50. Philadelphia: Rees Welsh & Co. 1907.

Reserved for later notice.

Bond, Beverly, Jr. *The Monroe Mission to France, 1794-1796.* Pp. 104. Baltimore: The Johns Hopkins Press, 1907.

It is the professed purpose of the writer to present a detailed account

of this affair with a view to showing definitely the circumstances and motives of the actors. The diplomatic papers of the state department and the Monroe papers in the library of congress are found to shed new light on the inner history of this diplomatic game. The study clearly brings out the interesting fact that it was part of the game of the government to appoint Monroe as envoy to France. France was suspicious of the real purpose of Jay's mission to Great Britian. Monroe, an Anti-Federal and a strong French sympathizer, was sent to allay this suspicion. Due blame is accorded the American government for withholding from Monroe the full extent of Jay's powers, and so using him as a means of practicing this deception on the French government. On the other hand, Monroe's weakness in posing as the representative of the American people instead of the government, of betraying too openly his feelings for France and of publicly criticizing the government, all receive due censure.

Belated praise is accorded Monroe for the creditable part he played in keeping France at peace at a critical period, in protecting American interests abroad and in helping to secure the treaties with Algiers and Spain. Altogether, it is an interesting bit of history, and the author has succeeded in shedding new light upon this episode.

Boyd, Carl Evans. *Cases on Constitutional Law.* Second edition. Pp. xi, 827. Price, $3.00. Chicago: Callaghan & Co., 1907.

This collection of cases, originally published in 1898, has been of increasing popularity for use in connection with courses on constitutional law. It is a compendious summary of the chief decisions on constitutional law, in somewhat over eight hundred pages. No selection can suit exactly the requirements of all students, but Mr. Boyd has made an excellent choice of cases which the average man will find well adapted to his wants.

The text is printed literally with the omission only of the arguments and statements of fact which are unnecessary for the illustration of the point of law involved. The notes are few as the author has preferred to use the space they would have taken for additional decisions. The present edition contains a supplement giving the chief decisions from 1898 to the spring of 1904. The type and paper are good and a substantial buckram binding insures the wearing qualities of the book.

Boynton, F. D. *School Civics.* Pp. xli, 368. Price, $1.00. Boston: Ginn & Co. 1907.

Brewster, William N. *The Evolution of New China.* Pp. 316. Price, $1.25. Cincinnati: Jennings & Graham, 1907.

The book is the substance of a series of lectures delivered by the author before the students of the Boston University School of Theology. The object is to "discuss the trend of events," and the author, being a missionary, devoted somewhat over half the volume to the trend of things religious. For the average reader, therefore, the first half of the book holds the chief interest; the later chapters are hardly likely to appeal to anyone but the enthusiastic mission worker.

In the chapter on the "Greatness of China" is given a very clear and not seriously exaggerated summary of the tremendous resources of the empire, and a brief description of the highly-developed system of agriculture. It is certainly a most glowing future which the author's enthusiasm leads him to paint. The Chinese are to people the vast wilderness of Borneo; they are to be the dominant race of the eastern tropics, through intermarriage with the natives; they are to be the intellectual nation of the Orient; and they will largely control Oriental commerce "before the middle of this century. All of these conclusions are derived by the author from an analysis of Chinese character and things Chinese. It is often difficult, however, to follow some of the leaps in his logic.

From the political standpoint, Mr. Brewster regards China as "a great people, but an imbecile state; commercially sound, but politically rotten." This condition he ascribes to the presence of the Manchu rulers, a non-Chinese dynasty, on the throne, and the universal evil of political graft which, from examples cited, must even surpass that of our own more enlightened western civilization. The remedy for the first of these evils will be found in the impending constitutional government, and for the latter in the spread of Christianity, by which loyalty to the state will be made to replace the present attitude of ancestor worship and selfish interests.

The low industrial condition is not to be attributed to overpopulation, unproductive soil, laziness or intellectual incapacity, but to the fact that the "brain and the brawn are not united." In support of this argument, the author draws very vivid pictures of the primitive methods encountered in every field of labor. He believes firmly in the solution by industrial education, but weakens his argument by assuming that the education is to come from missionaries. Unfortunately, the average missionary knows all too little about farming implements and machine shops. Mr. Brewster's enthusiasm for his work appears to have obscured his recognition of the fact that trade and commerce and general world intercourse are the factors which have lifted nations in the past and must be expected to do the major part of the work in the future.

The main theme of the book appears to be that missions and the spread of Christianity will prove the solution of all difficulties and make China the foremost nation of the East. But the experience in Japan and recent progress there are not easily reconciled to this view.

Brisco, Norris A. *The Economic Policy of Robert Walpole.* Pp. 217. Price, $1.50. New York: Macmillan Company, 1907.

Thorough study has been accorded to the large part played by Robert Walpole in the constitutional history of his period and to his political and foreign policy; scant and only incidental treatment to Walpole, the financier and economist. It is an era of great questions in politics and foreign policies. It is likewise an era of important financial and economic questions. As the author says, "There has hitherto been no systematic treatment of the economic policy of Robert Walpole, and it was felt here was a field for study."

This comprehensive and orderly treatment is a welcome addition to the

library of the student of economics. But it has also a great value to the student of political history, for historians are realizing to a greater degree the modifying influence of economic affairs on the course of political events.

To his fiscal policy one chapter is devoted. An account is given of Walpole's sound financial judgment amidst the disorders attendant upon the bursting of the speculative bubble, as likewise of his keen foresight in restoring confidence in the government by instituting a sinking fund to guarantee payment of the national debt. Walpole was a firm advocate of the merchantilistic policy of trade. A discussion of his endeavors to put this policy into practice by reforms in the taxes and customs duties covers two chapters. His excise plan and his efforts to repeal the duties on imports met great opposition and, in general, failed of realization, and shows that Walpole as a reformer was simply in advance of his time. The student of colonial history will find an interesting and able chapter on Walpole's colonial policy and his system of bounties. To his work of developing home industry and building up a foreign trade, two chapters are allotted. The monograph is well and clearly written.

Browne, H. A. *Bonaparte in Egypt and the Egyptians of To-Day.* Pp. 410. Price, $3.00. New York: Charles Scribner's Sons, Importers. 1907.

Reserved for later notice.

Bullock, Charles J. *Finances and Financial Policy of Massachusetts from 1780 to 1905.* Pp. 144. Price, $1.00. New York: American Economic Association, 1907.

This historical sketch of the finances of Massachusetts as a commonwealth for a century and a quarter is purely one of general questions of finance without regard to details of legislation or administration. The author "has been content to describe policies, estimate critically their results, and allow the narrative to point its own moral, if moral it has."

The financial history of the state is divided into six periods, to each of which is devoted a chapter. The first period, from 1780-1794, is one concerned with the efforts towards the rehabilitation of disordered finances, the heritage of Revolutionary days. The next period, 1794-1825, witnesses the extinction of the debt and times of financial prosperity. The period from 1825 to 1860 is probably one of the most dramatic interest in the annals of state finances. In the history of Massachusetts it is an era of internal improvements, and of general prosperity attendant upon the speculative movement which had its climax in the panic of 1837, and it sees the gradually widening gap between expenditures and revenues and the unsuccessful efforts to avoid a state tax. The history of state finances of this period has been neglected and there is need of a comprehensive and orderly treatment of the disordered finances of the states, with the question of financing internal improvements, issues of bonds, repudiation of bonds, and assumption of these debts by the federal government.

The Civil War period is one of onerous financial burdens, caused by war loans, with the necessity of finding new sources of income. The period after the war, down to 1880, concerns itself with the difficulties of financing

railroad enterprises, of the crisis of 1873 and the consequent retrenchment in all the departments of the government. The last quarter of a century is one of steady increase in state expenditures and growth of a new state debt.

The appendix contains tables of statistics of state tax from 1789 to 1905, and the ordinary revenues and expenditures for the period of 1816 to 1860. There is also a bibliography. Works dealing with figures and finances are apt to be dry and dull, but it is a pleasure to find in this monograph an account very clear, comprehensive and readable.

Bureau of American Ethnology. Twenty-fourth Annual Report. 1902-03. Pp. xl, 846. Washington: Government Printing Office, 1907.

In addition to the usual reports of the work done by the bureau, this volume contains an excellent monograph, by Stewart Culin, on the Games of the North American Indians, which is by all odds the best study of the subject in print, and should go far towards dispelling much of the still extant popular tradition that the Indian was sullen and morose, with no fondness for play. There are many illustrations accompanying the text.

Bureau of American Ethnology. Twenty-fifth Annual Report. 1903-04. Pp. xxix, 296. Plates cxxix. Washington: Government Printing Office, 1907.

The two papers in this volume were written by Dr. Jesse Walter Fewkes. The first, on "The Aborigines of Porto Rico and Neighboring Islands," is an important contribution to our meager knowledge of the earlier inhabitants of these islands, even if the material is largely drawn from early accounts, supplemented, so far as possible, by personal observation of extant remains. The second paper deals with "Certain Antiquities of Eastern Mexico"—a description of some important ruins and cultural objects. The text is supplemented by a large number of plates.

Calvert, A. F., and Gallichan, W. M. *Cordova.* Pp. 108, 159 plates New York: John Lane Co., 1907.

This book is well planned to put the reader in a frame of mind to appreciate the charm of Cordova, the ancient Moslem capital of Spain. To do the city justice one must love the past and see file before him the various nationalities which at different periods have contributed the elements which in ruins make up the Cordova of to-day.

Beautifully situated in a fertile valley surrounded by rugged mountains, clean,—for a Spanish city,—quiet, prosperous, but wholly lacking in enterprise, and with its face turned toward the past, the city is possessed by a certain unreality which adds greatly to its charm. It is not forbidding, as is Toledo, nor has it the air of desertion present in so many of the old Spanish cities, but it is a capital left one side by the stream of present-day life and fully content to preserve its mediæval characteristics.

The author has excellent powers of description, and leads us around the city and through the mosque in a way that enables the reader to catch the spirit of the place exceptionally well. A historical sketch of three chapters gives the setting of the town in the life of the peninsula, and

another chapter introduces us to its famous sons, Seneca, Lucan, El Gran Capitan and others less noted. One hundred and fifty-nine excellent plates give an outlook upon the chief objects of interest. These form almost half of the book and contribute to its value in at least the same proportion.

Calvert, T. H. *Regulation of Commerce under the Federal Constitution.* Pp. xiv, 380. Price, $3.00. Northport, N. Y.: E. Thompson Co. 1907.
Reserved for later notice.

Casson, H. N. *The Romance of Steel.* Pp. xiv, 376. Price, $2.50. New York: A. S. Barnes & Co. 1907.
See Book Reviews.

Chatterton-Hill, George. *Heredity and Selection in Sociology.* Pp. xxx, 571. Price, $4.50. New York: The Macmillan Co., 1907.
"It will suffice to say that training in sociology must be preceded by training in biology; and that none of the great problems of sociology can be understood, much less solved, unless the sociologist possesses sufficient training in biology, and sufficient knowledge of the facts concerning heredity and selection." The book begins, therefore, with a long and really good discussion of heredity. Our criticism upon these first one hundred and sixty pages is that the author has allowed himself to be drawn too much into the discussion of moot points which should be left to the biologist, and that he has clung too closely to the ideas of Weismann and seemingly underrated the work of De Vries. It is almost needless to add that the theory of the inheritance of acquired characteristics is rejected.

The chief criticism of the rest of the volume is its lack of plan or continuity and the wholly eclectic method of treatment. Some chapters seem to be reprints of articles elsewhere used, while within a given chapter very divergent topics are considered. Over one hundred pages are devoted to Part II—Social Pathology, which includes six chapters—Suicide, Insanity and Syphilis as Social Factors; Social Selection and Inverse Selection; Conflict and Progress; Concluding Remarks. Occasionally there is very careless use of language or else the author forgets his biology, as when he writes of "hereditary syphilis."

In Part III he discusses The Biological and Traditional Factors of Race Progress; The Bankruptcy of Liberalism; Socialism and Science; Religion as a Social Force. At times he seems to think that society is going to decay. Neither liberalism, socialism, science nor Christianity will be effective in promoting social development. Although Christianity as now understood will fail, yet some religious system will develop. Although Mr. Hill disputes Mr. Benjamin Kidd's arguments he nevertheless agrees in "the necessity of a supra-rational ideal for the individual and society."

For the general idea of the author there is much to be said. His present exposition is not satisfactory and should not be final. Many of the criticisms and suggestions he makes are very valuable and deserve attention. "Instead of seeking to extirpate diseased living generations, in the interests of the race which is to come after us, every resource of applied science

is devoted to prolonging the life of weak and biologically useless persons, thus permitting their reproduction"; or again, "So far, then, as altruistic influences are at work in social evolution, it is impossible to admit the beneficial tendencies of these influences." If true, these developments demand radical action. The volume deserves the attention of serious students.

Commons, John R. *Proportional Representation.* Pp. x, 369. Price, $1.25. New York: Macmillan Co., 1907.

This is a reprint of a well-known text first published in 1896. The clearly discussed thesis of the book is already familiar to our readers. Six appendices bring the subject down to date and place greater stress upon certain subjects than was given them in the original work. Primary elections and the initiative and referendum, especially in their relation to municipal government, are considered here. The additions to the book serve to reinforce the argument against the injustice of our present method of elections and to demonstrate one of the causes of the much discussed "failure of representative government."

Conyngton, T. *The Modern Corporation.* 2d Ed. Pp. xii, 290. Price, $2.00. New York: Ronald Press. 1907.

Reserved for later notice.

Cotes, E. *Signs and Portents in the Far East.* Pp. xi, 308. Price, $2.50. New York: G P. Putnam's Sons. 1907.

Reserved for later notice.

Creanga, G. D. *Grunbesitzverteilung und Bauernfrage in Rumänien.* Pp. 207. Price, 5.40m. Leipzig: Duncker & Humblot. 1907.

Cronbach, E. *Die Osterreichische Spitzenhausindustrie.* Pp. 212. Price, 5m. Wien: Franz Deuticke. 1907.

Cronbach, E. *Das landwirtschaftliche Betriebsproblem.* Pp. 338. Wien: Carl Konegen. 1907.

Day, C. *A History of Commerce.* Pp. xli, 626. Price, $2.00. New York: Longmans, Green & Co. 1907.

Reserved for later notice.

Dow, E. W. *Atlas of European History.* Pp. 46. Plates, 32. New York: Henry Holt & Co., 1907.

Maps well used are one of the most efficient aids in impressing the facts of history connected with the national territorial growth upon the mind of the student. This excellent collection has the virtue not only of being published at a moderate price, but covers the historical development of the European nations from earliest times down to the present—not for a single period only. The presentation is made in detail great enough to meet the needs of one intent upon a special field and embodies the results of the best European historical map making.

Dunning, W. A. *Reconstruction: Political and Economic.* Pp. xvi, 378. Price, $2.00. New York: Harper & Bros. 1907.

Reserved for later notice.

Ein Land der Zukunft. By a German Officer. Pp. 274. Price, 5 m. Munich: J. Greger.

This interesting record of a trip through one of the most promising of South American republics gives the reader a vivid impression of both the accomplishments and needs of the Argentine. Contrasts are numerous. The finely planned capital and the raw provincial towns, the good railways and the impassable country roads, the unexhaustible agricultural resources of the pampas and the barrenness of the desert highlands and many others of the striking contrasts to be found in the republic are passed in review.

The national ambitions of Germany appear in the point of view of the writer constantly. Argentine is a land of the future, the best point for emigration in the twentieth century as the United States was in the nineteenth. Toward this land of promise German emigration should be consciously turned. The prosperous condition of the German colonists settled in the country is a matter of justifiable pride, but one is surprised to hear, in spite of the common belief in the preponderance of English capital and enterprise in this part of the world, that "Imports and Exports . . . are chiefly in the hands of Germans." The greatest German colony of the future, at least in an ethnic sense, should be in Argentina. Though this national caste pervades many of the pages the author gives interesting sketches of political, social, industrial and military developments which are of real value as sources of facts. The observations on present-day conditions are keen and apparently critical, though often the author allows himself to be lead for a page or two into the role of the prophet rather than that of the interpreter—a privilege which should be granted to an author who avowedly writes of a land of the future. In justice, it must be said, however, that as a rule the author walks "with his feet upon the ground."

The Argentine is to be the leader of South America. With the creation of a strong spirit of nationality and an army so strong as to impose peace on enemies both domestic and foreign, the country would at once spring into the position of permanent leader on the continent. This is in summary the message of the work.

Fabrication et Travail du Verre. Pp. xxiv, 263. Brussels: J. Lebègue et Cie. 1907.

Forbes-Lindsay, C. H. *The Philippines.* Pp. 566. Price, $3.00. Philadelphia: J. C. Winston Co., 1906.

This book is a reprint, under separate title, of volume two of the author's work, "America's Insular Possessions," reviewed in the ANNALS, July, 1907.

Forrest, J. Dorsey. *The Development of Western Civilization.* Pp. xii, 406. Price, $2.00. Chicago: The University of Chicago Press, 1907.

Primarily the book is a collection of historic facts tied together loosely and at times having little apparent connection. In that the work is disappointing, for one naturally expects a "development" to show an unbroken line of growth and advance. The work represents an enormous amount of research, but a woeful lack of classification and definite arrangement.

The author takes up first ancient society, and treats of the influence which Israel, Egypt and Phœnicia, Greece and Rome had on the later thought; then passes on to the problems of Mediæval Society; The Organization of Agriculture; The Development of Commerce; The Reformation; and ends with a discussion of modern social movements.

There is a tendency in the early part of the book to explain everything in terms of environment,—particularly geographical environment. For example, on page 24, is the statement that Greek characteristics "were due in part to geographical conditions, and in part to the social life which, as shown above, was largely determined by those conditions." In other words, geography, acting directly and indirectly, made Greek characteristics. While the advocates of the theory of the influence of geography on human actions and thought carry their ideas to extremes, they would scarcely make so far-reaching a statement as this one.

In dealing with social and economic problems the author shows a singular lack of appreciation of the practical side of questions. His statements are bookish and not careful or well considered. The discussion of such problems as the Factory System, the Industrial Revolution and the Rise of Socialism are disappointing.

Passing over the fact that the book makes difficult and rather uninteresting reading,—for that is a fault common to a great mass of recent literature on social science,—one may at least expect, on finishing a chapter, or section of a chapter, to have in mind some definite thought which the author has been trying to convey. But this is not the case with "The Development of Western Civilization."

The book suffers from a fault which has become unpleasantly common among modern works of the character. The author has assembled a large number of facts and has then written a book containing these facts, without making any great attempt to see that the facts formed a logical sequence, or that a consecutive thought formed a center for the book. In short, the facts in the present work are undigested. Facts should suggest ideas, and ideas should lead to conclusions, but the author has been satisfied with the facts.

Foulke, W. D. Translated by. *History of the Langobards,* by Paul the Deacon. Pp. 437. Price, $1.50. New York: Longmans, Green & Company, 1907.

This history, by Paul the Deacon, one of the best known authors of the Middle Ages, has been translated into German, French and Italian, but it has remained for the present translator to do a good work in giving the student an English version. The introduction contains a scholarly and careful treatment of the life and writings of Paul the Deacon with a historical and literary estimate of his work. The body of the history is accompanied with full explanatory and critical notes which show the work of a trained scholar. The appendices contain a discussion of the ethnological status of the Langobards; an account of the sources from which Paul derived his history, and a translation of Paul's poems. The volume also contains three very helpful and instructive maps, and a good index.

It is a splendid piece of work in every way, scholarly, scientific and painstaking. Students of Italian history will be grateful to the translator.

Friedman, H. G. *The Taxation of Corporations in Massachusetts.* Pp. 178. Price, $1.50. New York: Columbia University Press. 1907.

Garcia, G. *Correspondencia Secreta de los Principales Intervencionistas Mexicanos.* Pp. 316. Mexico: Ch. Bouret. 1907.

Gilbert, J. H. *Trade and Currency in Early Oregon.* Pp. 126. Price, $1.00. New York: Columbia University Press. 1907.

Goodrich, A. N. *Cruise and Captures of the Alabama.* Pp. 216. Price, 75 cents. Minneapolis: H. W. Wilson Co.

Griffis, W. E. *Corea, the Hermit Nation.* Pp. xxvii, 512. Price, $2.50. New York: Charles Scribner's Sons, 1907.

Five new chapters added to those contained in the former seven editions of Mr. Griffis' book made up the present work. Since 1882, when the first edition appeared, this book has been the most widely read interpretation of the little known and less understood country which has just recently passed out of the list of nations into that of dependencies. The author's intimacy with Oriental affairs through his former connection with the University of Tokio and his wide travel and long residence in eastern countries lends authority to his opinion. It comes as a relief after the severe adverse criticism to which almost all writers have subjected the Koreans to hear that there lies within the people at large the possibility of a regeneration. The author, however, does not blink the shortcomings of the government, and states many facts which point to the justification of the alleged "high-handed" policy of Japan. With the Japanese management of the situation he is not altogether satisfied. The Nipponese have been too careless in allowing the lower class, the adventurers and sharpers to stream into the country before the government had been established upon a basis such that it could cope with the new responsibilities. In its new form the book brings up to date a history filled with misfortunes and disappointments—the story of a nation ill-fated both on account of its peculiar international situation and the almost unexampled inefficiency of its ruling class.

Griffis, William Elliot. *The Japanese Nation in Evolution.* Pp. xii, 408. Price, $1.25. New York: Thomas Y. Crowell, 1907.

"The unchanging trait in a Japanese is to covet things better and ever to seek a more excellent way." With this point of view the author in his latest book on Japan traces the development of this people linking Orient and Occident, from their early Aryan ancestors, through picturesque and bloody Mongolian centuries up to their present "more excellent way." He affirms that "no other nation is so fitted to welcome the new without losing the old. . . . Little do they invent. Mightily do they adopt." Mr. Griffis' faith in Japan's possibilities of growth (based on his wide knowledge of country and people) is inspiring. He believes the Japanese to be "not only the most improvable race in Asia, but possibly even in the world."

An immense amount of material, geographical, legendary, archæological and historic, produces some confusion when condensed into so small a book, and the frequency of strange names adds further difficulty in reading.

Hague Ordains, As The. Pp. vi, 359. Price, $1.50. New York: Henry Holt & Co. 1907.
Reserved for later notice.

Haines, H. S. *Railway Corporations as Public Servants.* Pp. 233. Price, $1.50. New York: Macmillan Co. 1907.
Reserved for later notice.

Hainisch, M. *Die entstehung des Kapitalzinses.* Pp. 112. Price, 2.50m. Leipzig: Franz Deuticke. 1907.

Hall, Bolton. *Three Acres and Liberty.* Pp. xxii, 435. Price, $1.75. New York: Macmillan Company, 1907.

How can we be free from the burdens which city life has imposed upon us and from the uncertainty of securing a living in our modern industrial system? This is the question which the author attempts to answer in the four hundred pages of "Three Acres and Liberty." The book is really a brief for intensive farming. Only a few pages are devoted to theory, the greater number being taken up with very practical discussions of the kinds of crops that should be raised on certain lands, the character of land which should be purchased or rented and the method of treating this purchased or rented land after it has been secured.

The author deals in a very comprehensive way with many of the besetting problems of the small farmer. He gives instances of small farmers who have secured a living and paid off mortgages on two or three acres of land which others passed by as useless. The average American farmer does not know what intensive farming means. He "thinks that he has done well if he gets 150 or 200 bushels of potatoes from an acre. He does not know that others have gotten 1,284 bushels." By intensive culture, by care, by scientific methods, a man can raise on ten acres more and better produce than is raised by the average farmer on fifty acres.

Of course the book deals with small farming near the city more than with extensive farming in remote districts, one of the author's contentions being that a man moving out a few miles can enjoy all of the benefits of city life without incurring any of its discomforts. The book is well worth the careful consideration of any farmer who is producing truck; it is invaluable to any one who is contemplating small-scale farming near a large city; and it presents a ray of hope to the man in the city who, with a small salary and a large family, is struggling to make his salary meet his necessities and at the same time to secure for his children an education.

Hart, Gordon. *Woman and the Race.* Pp. 264. Price, $1.00. Westwood, Mass.: The Ariel Press, 1907.

The author deals in a very striking manner with the relation between modern women and the social organism. He says that one of the great

evils of the day is ignorance among young mothers. We would not dare entrust our national defence to an army which had never had any military training, and yet each year thousands of children are born whose mothers' only preparation for caring for the future generation has, in a great number of cases, been secured from playmates and companions whose ideas were not of the most desirable. Neither in the school nor in the home are men and women prepared for their reciprocal relations in life, and the marriage contract has generated into a mere joining together of persons who are often dissimilar in every thought and habit.

Upon the knowledge or lack of knowledge of these mothers and fathers will depend the joy or misery, health or sickness, happiness or wretchedness of millions of children. The author shows a wide knowledge and expresses his thought in a way that deserves an audience seldom accorded to a modern book not in novel form.

Hazen, Allen. *Clean Water and How to Get It.* Pp. x, 178. New York: John Wiley & Sons, 1907.

It is seldom that one finds a book dealing with a technical subject which has the universal interest of Mr. Hazen's recent volume. In the localities where the population is increasingly denser every year, the problem of preventing or overcoming contamination and pollution of the water supply is constantly more difficult to solve. Few municipalities can afford, or are so situated as to be able to control the entire catchment area from which their water supply is derived.

The opening chapters of the book deal with the relative advantages and disadvantages of the usual sources—reservoirs, lakes, rivers, and ground water. The river in most cases in the United States is the only source from which a sufficient quantity is available. The methods and devices for purifying water and the operation of systems under filtration form the main theme of the book. Throughout the volume the experiences of various American cities are cited, a fact which adds greatly to its practical value.

One chapter in particular, on the use and measurement of water, could be read with great profit by the citizens of many American cities where the daily consumption per capita, with no meters, is excessive. Mr. Hazen contends that such waste of water is needless, increasing the cost of supply by one-third or one-half. Mr. Hazen's other contention is that no man will object to paying for a supply of clean water.

The book is a valuable, as well as an interesting exposition of the most important question in present-day municipal problems.

Holman, Frederick V. *Dr. John McLoughlin, the Father of Oregon.* Pp. 301. Price, $2.50. Cleveland: the Arthur H. Clark Co., 1907.

This volume contains a biographical sketch of the "Father of Oregon," by which name Dr. John McLoughlin is known throughout the Northwest, because of the work he did as the representative of the Hudson Bay Company in the Oregon country. It comprises the history of the Oregon country until the establishment of the Oregon Territorial Government and includes

a statement of the early work and struggles of the Presbyterian and Methodist missions among the Indians.

The character of the early immigrants is pointed out as is also the kindness shown them by Dr. McLoughlin, who saved them from starvation and the onslaught of the Indians and aided them in the midst of their hardships.

The latter part of the work deals with a land claim of which Dr. McLoughlin was deprived, and sets him forth as being greatly persecuted. Documents and letters form an appendix to support this claim of injustice. The author in his preface does not claim this to be a full biography of Dr McLoughlin, but simply an enlargement upon an oral address delivered on McLoughlin Day during the Lewis and Clark Exposition.

Holt, Henry. *On the Civic Relations.* Pp. xxxi, 668. Price, $1.75. New York: Houghton, Mifflin & Co., 1907.

This is a reprint in enlarged form of the author's "Talks on Civics." Fortunately for the interest of the work it has been rewritten from the "question and answer" form into direct exposition which relieves it of the choppy character of the earlier editions. Further changes are made by writing in greater detail upon such divisions of the subjects treated as have, through recent developments, come to be of greater popular interest. These amplifications are especially important in the treatment given the labor question and socialism and municipal trading.

First designed for use by pupils of the common school, this work has outgrown its original purpose, though in portions a certain "juvenile" character has been presented both in manner of presentation and vocabulary. No pretense is made by the author to originality, but the discussions are presented in such form that they make an interesting and valuable storehouse of general information on civics for the public, to which the work is now addressed—the undergraduates of the colleges and the general reader.

Hone, Nathaniel J. *The Manor and Manorial Records.* Pp. xv, 357. Price, $3.00. New York: E. P. Dutton & Co., 1906.

This is a good book. It belongs to the series known as "The Antiquary's Books," although the American imprint does not state that fact. It will be understood then that it is not primarily a work of investigation. The author, however, uses documents freely for purposes of illustration, and his book obtains thereby much of the clearness and force usually accompanying work drawn immediately from the original sources. He has evidently examined many manorial records, though his generalizations are not drawn from them, but from the books of other men about them. These secondary works which he has utilized are in the main the best books on the subject. For the early period he has been especially dependent on Vinogradoff, "Growth of the Manor," and to a less degree on the same author's "Villainage in England." Altogether, the work is a clear, moderate, sensible and readable description of the main characteristics of the mediæval manor.

It is noticeable how much clearer the knowledge of the mediæval

manor has become since it has been approached from an economic rather than from a legal point of view. It is true that the manor is in some senses a legal conception. But this aspect of the manor is vague, artificial, arbitrary, comprehensible only by lawyers, and in their minds quite detached from material reality. Mr. Hone gives such a definition in his preface. "A certain circuit of ground granted by the king to some baron or man of worth as an inheritance for him and his heirs, with the exercise of such jurisdiction within the said compass as the king saw fit to grant, and subject to the performance of such services and yearly rents as were by the grant required." As one studies English history one searches in vain for any actual process such as here described, and as one reads manorial records,—extents, *compotus* rolls, and court rolls, the picture that rises in one's mind bears no resemblance whatever to the lawyers' definition.

On the other hand the conception of the manor as primarily an agricultural organization, the demesne farm of the lord of the manor intermingled with the small holdings of the tenants, the whole held together by agricultural as well as legal and social bonds—a little community carrying on its economic as well as its legal life, under the control of, and largely for the benefit of, the lord of the manor, we get something tangible, which a fuller study of the records, manorial and national, steadily tends to clear up.

The material for such fuller study is shown to exist in great abundance by Mr. Hone's lists of court rolls, given in his appendix. This is a most valuable and serious contribution to the subject. The main body of court-rolls in the Public Record Office is already listed in the Deputy Keeper of the Rolls' Series of Lists and Indexes, No. 6. In addition to this, however, Mr. Hone has printed lists of the court rolls existing in the custody of the Ecclesiastical Commissioners, of the Land Revenue Office, of the British Museum, Lambeth Palace, and the Bodleian Library. These lists show the striking extent of these records.

It may be remarked that this bibliography discloses one of Mr. Hone's deficiencies, his relative unfamiliarity with American and German work on his subject. He makes no mention, for instance, of Ashley, Page, Gay, or Cheyney; Meitzen or Schmoller, all of whom have contributed directly to his subject and a reading of whose contributions would have saved him from his weak or mistaken treatment of the commutation of services, of the enclosures of the fifteenth and sixteenth centuries, and perhaps of some of the other branches of his study.

Howe, F. C. *The British City.* Pp. xvi, 370. Price, $1.50. New York: Chas. Scribner's Sons. 1907.

Reserved for later notice.

Hueffner, Ford Madox. *England and the English.* Pp. xxi, 354. Price, $2.00. New York: McClure, Phillips & Co., 1907.

To undertake the interpretation of the spirit which characterizes a nation of people appears at first glance to be a large task, yet the author of "England and the English" has struck the right note in a most delightful manner.

The book covers the subject in three general parts, the first devoted to the many sides of life in London and what the real London and Londoner are; the second part is devoted to the country folk; and the third, to the English spirit in general.

The most striking feature of the volume is the touch of "local atmosphere," giving the whole an air of reality in the reader's mind, and creating an entirely new appreciation of the forces which make things English so distinctive. Many a page in the book rambles on rather aimlessly or with an over abundance of attention to minute details.

There is, however, an elusive charm about the book which seems to lie in this very approach to unconscious garrulousness. It suggests "Cranford" with its gossipy, ever delightful glimpses into the life of that provincial village. It is a book for many hours of most enjoyable reading, for it gives a picture of England and the English to-day in the same way that Mrs. Gaskill portrayed the rural life of a single provincial village—an appreciation of his country and countrymen by an Englishman.

Hulbert, A. B. *The Ohio River.* Pp. xiv, 378. Price, $3.50. New York: G. P. Putnam's Sons. 1906.

Reserved for later notice.

Hutchinson, Alfred L. *The Limit of Wealth.* Pp. 279. Price, $1.25. New York: The Macmillan Company, 1907.

The book contains an account, dated A. D. 1944, of changes brought about in the industrial system of the United States as the result of a suggestion made in 1913 by a Wisconsin school master. The proposal was in brief: "Limit the amount of wealth," which each man may accumulate.

The program consists of an income tax and an inheritance tax, amounting in some instances to confiscation,—based on ideas that have been advocated for years by reformers and recently by President Roosevelt. This scheme was put through at a general election in 1912. The wealth which was thus confiscated to the government was used for three purposes,—five billion dollars was appropriated for roads; five hundred million was appropriated for charity; and the government established a bureau of insurance. At the same time, the post office passed into the hands of a company which cut the cost of operation in half and reduced the expense to the public in the same proportion. In its conception the book is childish. The author writes like a man who knows nothing of the practical workings of the modern government.

International Arbitration. Report of the thirteenth annual meeting of the Lake Mohonk Conference. 1907. Pp. 209.

Jordan, D. S. *The College and the Man.* Pp. 78. Price, 80 cents. Boston: American Unitarian Association. 1907.

Jordan, David Starr. *The Human Harvest.* Pp. 122. Price, $1.00. Boston: American Unitarian Association. 1907.

In this little volume President Jordan, of Leland Stanford, combines two popular lectures which deserve attention for literary style and form. If it

be recalled that the author is one of the most eminent biologists of the country his subtitle, "A study of the decay of races through the survival of the unfit," becomes significant. The book calls attention to certain factors in human life which may easily be underestimated, but which are of fundamental importance. The "survival of the unfit" is a serious menace to civilization. Can it be stopped? Professor Jordan thinks so.

Kirkup, Thomas. *An Inquiry into Socialism.* Pp. 216. Price, $1.75. New York: Longmans, Green & Co., 1907.

Students of socialism will welcome the re-appearence, in revised and enlarged form, of Kirkup's standard little manual, which has been out of print since 1890. It is an unpretending, sympathetic, eminently fair exposition of the claims of a reasonable socialism, a statement and discussion of the objections to such a policy, and a consideration of its place and prospects in the democratic society of the twentieth century. Accordingly it will please neither the hide-bound individualist who learned his economics in the pre-Victorian era, nor the doctrinaire socialist who believes in the plenary inspiration of Karl Marx; but it may be cordially recommended to everyone who wants to understand present-day socialism of the less extreme type. While the author makes no attempt to cover the same ground gone over in his admirable "History of Socialism," he puts the socialistic movement in its proper perspective by an introductory account of the rise and the character of capitalism. Many readers will doubtless think Kirkup unduly favorable to socialism, but after all, we have passed the point when it seemed worth while to quarrel over names, and should be ready to discuss every social policy on its merits. Kirkup's book is an honest and successful attempt to discuss socialistic ideas in that way.

Kroeber, A. L. *The Religion of the Indians of California.* Pp. 37. Price, 50 cents. Berkeley: University of California Press. 1907.

Labriola, Antonio. *Socialism and Philosophy.* Pp. 260. Chicago: Charles H. Kerr & Company, 1907.

The book consists of a number of letters written by the author to a friend. Its style is, on the whole, very entertaining and makes remarkably easy reading, when contrasted with many books dealing with similar topics. However, there is not sufficient connection between the various letters to permit the reader to feel that he is reading a book but rather a number of short dissertations on several rather diverse topics. Some of the earlier letters are brilliant in conception, and the statements of theory are remarkably clear.

The first letter touches a vital chord in its description of the ambition which the average writer on socialism entertains of getting the ego before the theory. The second letter is an attempt to show the importance of having the work of Marx and Engels clearly understood by the general public and particularly by students of socialism, who are often deceived by misrepresentations concerning what Marx and Engels actually did say. Chapter four is devoted to a discussion of the possibility of starting a school of materialism in France. Chapters five, six and seven deal in a

very general and indefinite manner with the relation between philosophy and socialism.

Either the title of the book is unfortunate, or else the author forgets the subject on which he is writing, for only two or three letters fall naturally under such a title as "Socialism and Philosophy," and, on the whole, the book will not place the theory or practical workings of socialism in a more favorable light before the public.

Lafargue, Paul. *The Right to be Lazy.* Pp. 164. La Monte, Robert R. *Socialism Positive and Negative.* Pp. 149. Marx, Karl. *Revolution and Counter Revolution.* Pp. 192. Spargo, John. *Capitalist and Laborer.* Pp. 122. Chicago: Charles H. Kerr & Co., 1907.

Four interesting little books dealing with the problems of socialism and similar questions.

"The Right to be Lazy" is a translation by Charles H. Kerr of a most interesting essay presenting the opposition to the ideas ordinarily advanced in modern Anglo-Saxon communities on the subject of work. The author speaks of work as a thing to be dreaded rather than sought. His essay is a plea for the modern member of industrial society who is sold to work, and in his mania for working is forgetting to live and enjoy. The essay carries this idea to an extreme not often seen, and yet it contains a germ of truth which many of the members of our community, particularly in our modern city would do well to note and heed. The essay is strong, well written and interesting, and for the man who is studying modern economic problems well worth reading.

The chief thing in "Capitalist and Laborer" is Mr. Spargo's answer to an attack on socialism. Like all of Mr. Spargo's work, this answer is not brilliant, but honest, direct and dependable. It contains, stated in a very concise form, the main doctrines of the modern socialist.

"Socialism Positive and Negative," by La Monte, is a book of disconnected essays dealing with "Science and Socialism." "Markism and Ethics," "The Nihilism of Socialism," and like subjects. There is no connection between the essays and, on the whole, they do not present as satisfactory a statement of the socialistic doctrines as does Mr. Spargo's book noted above.

"Revolution and Counter Revolution" contains a series of letters written by Karl Marx for the New York Tribune, during the Revolution of 1848 in Germany. For the first time, these articles are collected and printed in book form. While wholly historical, they present a very interesting point of view on the German crisis in the middle of the last century.

This series of books represents an attempt by the publisher to place in handy and cheap form a number of essays dealing with socialism and socialistic problems. The effort is a commendable one and it deserves public support because of the reasonable figures at which the material is presented to the public as well as for the value of the material itself.

Lee, G. W. *The Library and the Business Man.* Pp. 64. Boston: Stone & Webster. 1907.

Législation du Travail. Annuaire de la. Pp. 690. Price, 3 fr. 20 c. Brussels: J. Lebègue & Cie., 1907.

This annual contains the labor legislation which has been passed in the various European countries and their colonies and in the United States during the year 1906. A great variety of subjects are treated: factory legislation, workingmen's insurance, regulation of minimum wage, investigation and arbitration of strikes and lockouts. On examining the contents of the volume one is impressed with the part which the administrative power plays in such regulations in Europe, the so-called "legislation" including both laws in our sense and ministerial and royal decrees.

The availability of any one report of this series is limited by the fact that many of the acts or ordinances are amendatory, and hence must be construed by previous acts which are not given. But the value of the whole is enhanced by the publication of a decennial table which classifies the legislation both by countries and by subjects—the latter being especially interesting.

That there have been some oversights on the part of the individuals making the reports for the several countries, is evidenced by the omission of two Pennsylvania statutes: a workshop act of 1899 and a store-order act of 1901. But notwithstanding such omissions the Belgian *Office du Travail* is making a noteworthy contribution to the subject.

Macrosty, H. W. *The Trust Movement in British Industry.* Pp. xxi, 398. Price, $2.50. New York: Longmans, Green & Co., 1907.

This book is largely devoted to a statement of the facts regarding combinations in England. Under the term "Trusts" are grouped all of the amalgamations and combinations which have for their object the regulation of prices. The volume is a bit disappointing because it represents nothing more than the results which might be obtained by an ordinary legislative commission. Facts it presents, and to spare, but they are scarcely digested, and no definite conclusions are drawn from them.

As a source of information to the student of the trust movement abroad, the work will be of considerable value, but such work can be equally well done by more cumbersome bodies. The book is hard to read. The paragraphs are long and tiresome. The style is clumsy. We need thought—but that thought must be transmitted by means of good English.

Meyer, H. R. *The British State Telegraphs.* Pp. xvii, 408. Price, $1.50. New York: Macmillan Co. 1907.

Reserved for later notice.

Meyer, H. R. *Public Ownership and the Telephone in Great Britain.* Pp. xviii, 386. Price, $1.50. New York: Macmillan Co. 1907.

Reserved for later notice.

Miyakawa, Masuji. *The Life of Japan.* Pp. 331. Price, $3.00. New York: Baker & Taylor Co., 1907.

This volume is a description of the life of the people of Japan from the popular standpoint by a native of the great Island Empire. The book is written in an interesting style throughout and tells those things which we

most want to know about Japan. The daily life of the people, the ideals and standards of their society, the historical reasons for these ideals, the industrial development of recent years, the outlines of the national government, and the recent discussions of a possible American-Japanese war are all considered in an informal, semi-conversational style, which lends special attractiveness to the book. An elaborate series of tinted illustrations setting forth the different phases of the every-day life of Japan give a distinctive tone to each page.

Dr. Miyakawa's object in writing the book is clearly one of which all progressive men of both nationalities must approve, that of bringing the two peoples to a clear understanding of each other, and the work is well calculated to fulfil this object.

Morris, C. *Home Life in all Lands.* Pp. 316. Price, $1.00. Philadelphia: J. B. Lippincott Co. 1907.
Reserved for later notice.

Munro, D. C., and Sellery, G. C. *Mediæval Civilization.* Pp. x, 594. Price, $2.00. New York: Century Co. 1907.
Reserved for later notice.

Neame, L. E. *The Asiatic Danger in the Colonies.* London: S. Roulledge & Sons, 1907.
The keynote of this volume might be given as "all land that can be settled by the whiteman should be kept exclusively for his use." The author writes from South Africa and knows from experience the acuteness of the race and labor problems there. The discussion extends, however, to Australia and the West Indies. His argument is based, he insists, not on color, but on the unassimilability of Asiatic races on account of economic standards of life with which the European cannot compete, and social standards with which he cannot sympathize. South Africa and Australia must be saved as a ground upon which the white race may expand. The West Indies and the tropics in general can well be surrendered to the Asiatics.

New York State Library. Yearbook of Legislation, 1906. Price, $1.00. Albany: N. Y. State Educational Department. 1907.

Osgood, H. L. *The American Colonies in the Seventeenth Century.* Vol. III. Pp. xxii, 551. Price, $3.00. New York: Macmillan Co. 1907.
See Book Reviews.

Parloa, Maria. *Home Economics.* Pp. xii, 416. Price, $1.50. New York: Century Company.
There is, in this country, a steadily increasing interest in home economics. Miss Parloa's book on this subject will recommend itself to all progressive housekeepers as an authoritative hand book. Miss Parloa was founder of the original cooking-school in Boston and is the author of several well-known books. "There seems to be a need for a book that deals with the necessities of daily home life, that teaches the housekeeper the materials and forces with which she has to deal, and the way in which they should be treated. This book has been planned upon this basis. Every statement has

been thoroughly tested by the author in the years that she has devoted to the study and experiments which have made this volume possible."

Patten, S. N. *The New Basis of Civilization.* Pp. 220. Price, $1.00. New York: Macmillan Co. 1907.

Reserved for later notice.

Peary, R. E. *Nearest the Pole.* Pp. xx, 411. Price, $4.80. New York: Doubleday, Page & Co. 1907.

Reserved for later notice.

Poorman, C. I. *The Conflict of the Ages.* Pp. 352. Price, $1.25. Bellaire, Ohio: Published by the Author, 1907.

In all ages men have been either oppressors or oppressed, whether as slave and master, or serf and lord, this unnatural condition of society has always been overthrown and succeeded by some other system which likewise contains oppressors and oppressed. We are approaching a crisis with our system of wage worker and wage payer. The thought is emphasized that this idea of change in our present system is not confined to "visionary dreamers" and "pessimistic fault-finders."

In dealing with the trusts and their influence upon the development of the country, the author takes a very pessimistic view. Fully half of his book is devoted to this subject,—and many interesting facts are presented regarding trust oppression and trust methods which will be new to most readers. Omitting the benefits derived from large-scale production, the author deals only with the wrongs which have arisen from the unjustified use of the power by large corporations

The book concludes with statements showing how the reign of Christian socialism can be brought about by a peaceful revolution. It is free from bitterness or prejudice, strongly written, and based upon a group of new and well-arranged facts.

Pratt, E. A. *German versus British Railways.* Pp. 64. Price 1s. London: P. S. King & Son. 1907.

Pratt, E. A. *State Railways.* Pp. 107. Price 1s. London: P. S. King & Son. 1907.

de Quesda, G. *Arbitration in Latin America.* Pp. xiii, 136. Rotterdam: M. Wyt & Zonen. 1907.

Richards, R. C. *Railroad Accidents: Their Cause and Prevention.* Pp. 111. Boston: The Association of Railway Claim Agents, 1907.

The author presents in a very interesting way the question of railway accidents, his purpose being to render them less frequent and less severe by calling the attention of railroad companies and railroad employees to their really serious character and to the fact that in a great proportion of cases they are easily preventable by the exercise of a little care. The book is a small one, somewhat technical, and written from the standpoint of a person who understands railroading.

It divides accidents into four classes. First, those unavoidable, or

those caused by the act of God, or the public enemy; secondly, accidents to passengers and other outsiders due partly to their own negligence; thirdly, those due to the want of care on the part of the management, and fourthly, those caused by the carelessness or neglect of employees. These various groups are again subdivided, the character of individual accidents pointed out, and remedies suggested in each case.

The author livens up the work by printing a large number of actual instances of accidents to prove his theories. His general conclusion in regard to the cause of accidents is not at all specific, and the remedies proposed are very vague. The book is written for railroad employees rather than the general public.

Ross, E. A. *Sin and Society.* Pp. xi, 167. Price, $1.00. Boston: Houghton, Mifflin & Co. 1907.
See Book Reviews.

Salamond, J. W. *Jurisprudence, or the Theory of Law.* Pp. xv, 518. London: Stevens and Haynes. 1907.
Reserved for later notice.

Schmoller, G. *Jahrbuch fur Gesetzgebung, Verwaltung und Volkswirtschaft.* Pp. 476. Price, 11m. Leipzig: Duncker & Humblot. 1907.

Schuster, E. J. *The Principles of German Civil Law.* Pp. xlvi, 684. Price, 12s. 6d. Oxford: Clarendon Press. 1907.
See Book Reviews.

Smith, A. H. *China and America To-Day.* Pp. 256. Price, $1.25. New York: F. H. Revell Co. 1907.
Reserved for later notice.

Smith, S. G. *The Industrial Conflict.* Pp. 217. Price, $1.00. New York: F. H. Revell Co. 1907.
See Book Reviews.

Snyder, C. *American Railways as Investments.* Pp. 762. Price, $3.20. New York: Moody Corporation. 1907.
Reserved for later notice.

Snyder, Carl. *The World Machine.* Pp. xvi, 488. Price, $2.50. New York: Longmans, Green & Co., 1907.

The Universe is a machine working in consequence of unchangeable laws which operate none the less surely because we fail to understand them. In the machine the earth is an atom.

The author's scheme is an extensive one. He proposes to create a modern, cosmic philosophy based on the researches of modern science. The book under consideration, "The Cosmic Mechanism," is but the first of three volumes. The remaining volumes will deal with "The Mechanism of Life" and "The Social Mechanism." "In a larger sense we may now perceive that the development of a science of the earth and sun and stars, like human development in general, is an integral part of that vast scheme of evolution, of unfolding and becoming, which pervades the world."

Within the past few years considerable attention has been paid to the arguments advanced by the metaphysicists. "There is no matter." "Matter is an illusion." To the author, matter is the foundation. There is but one cause and that physical,—the influence of past development, heredity, the influence of our present surroundings, environment. "The change was slow, the path obscure and difficult. Probably the hardest thing the human race has had put before it to learn was the idea of fixity and consequence; the certitude that one event follows inevitably from another—the notion, as we say, of cause and effect; in Hume's phrase, of invariable sequence; what we have come in latter days to style the reign of law."

The first volume does not relate to man. It treats only of the development of a conception of the Universe. It might well be mistaken for a treatise on philosophy, or in part on physics. As an introduction to the study of the social mechanism, which is baffling so many thinkers, it is able and admirable. The style is clear,—the construction good. The work of Kepler and Galileo is easily made difficult for thinkers and impossible for common men. Of that there is no question. The author has handled theories with marvelous clearness and stated the evolution of our world concepts in a plain lucid manner.

Sociological Papers. Vol. III. Pp. vii, 382. Price, $3.25. New York: The Macmillan Co., 1907.

This volume includes the papers read before the Sociological Society (London) during the year 1906 and the discussions thereof. It is fully up to the standard of the first two volumes. The topics embrace a wide range of subjects, special attention being given to eugenics and biological factors. The writers and their subjects are: Dr. G. Archdall Reid, "The Biological Foundation of Sociology;" W. McDougall, "A Practicable Eugenic Suggestion;" Dr. J. Lionel Tayler, "The Study of Individuals (Individuology) and their Natural Groupings (Sociology);" Professor J. Arthur Thompson, "The Sociological Appeal to Biology;" Professor Patrick Geddes, "A Suggested Plan for a Civic Museum (or Civic Exhibition) and its Associated Studies;" A. E. Crawley, "The Origin and Function of Religion;" Professor R. M. Wenley, "Sociology as an Academic Subject;" G. de Wesselitsky, "The Russian Revolution;" W. H. Beveridge, "The Problem of the Unemployed;" Mrs. Sidney Webb, "Methods of Investigation;" H. G. Wells, "The So-Called Science of Sociology."

Speed, T. *The Union Cause in Kentucky.* 1860-1865. Pp. xxiii, 355. Price, $2.50. New York: G. P. Putnam's Sons. 1907.

See Book Reviews.

Steiner, Bernard C. *Maryland during the English Civil Wars.* Part II. Pp. 188. Price, 50 cents. Baltimore: Johns Hopkins Press, 1907.

This is the completion of Dr. Steiner's series of monographs dealing with the early narrative history of Maryland, a study based primarily upon the recently published "Archives of Maryland." The present number includes an account of events from 1643 to 1649, closing with a description of the work of the famous assembly of the latter year. The author has followed

in detail the frequent and confusing changes of government during this period, the Ingle trouble of 1644 and the resultant "plundering time" of the year following, and the constitutional progress made during the administrations of Thomas Greene and William Stone.

As must necessarily be the case, many minor matters, interesting in themselves but of small comparative importance, are included in such a series of studies. It is the function of the author of monographs to bring together all the known details of his subject, leaving to the author of more extended treatments the choice of materials from the monograph. Professor Steiner is doing excellent work in the former of these two fields of labor.

Sumner, W. G. *Folkways.* Pp. 692. Price, $3.00. Boston: Ginn & Co. 1907.

Reserved for later notice.

Terlinden, Ch. *Guillaume Ier Roi des Pays-Bas et L'Eglise Catholique-en Belgique* (1814-30). Two vols. Pp. xxi, 987. Brussels: Albert Dewit, 1906.

This is a scholarly work in two volumes published under the auspices of the department of Social and Political Sciences of the University of Louvain. The first volume deals with the period from 1814 to 1826, and the subsidiary title" The Conflict Between the Church and State" is significant, giving the keynote to that stormy period immediately following the establishment by the Congress of Vienna of the union of Belgium and Holland.

The author writes from the Catholic, and of course, the Belgian standpoint; he frankly states that he sets out to examine the history of the kingdom of the Low Countries from the point of view of the Catholic religion. But this does not necessarily make his work unscientific; much of the material used is new, being drawn directly from the Vatican and other archives. His thesis is that the religious question was one of the leading, if not the first cause, of the overthrow of the Kingdom of the United Netherlands, and hence of the independence of Belgium. After treating the difficulties between William I and the Holy See, the work shows how the conflict resulted in the unexpected alliance between Liberals and Catholics, and this unnatural alliance, the author claims, guaranteed the success of the Belgian revolution. Space prevents an extended review. The work furnishes an excellent treatment of this phase of Dutch-Belgic relations during a period when the two peoples were unwilling mates under the same yoke.

Trevelyan, G. A. *The American Revolution.* Part III. Pp. xii, 492. Price, $2.50. New York: Longmans, Green & Co. 1907.

Reserved for later notice.

Watson, W. P. *The Future of Japan* Pp. xxxi, 389. Price, $3.50. New York: E. P. Dutton & Co. 1907.

Reserved for later notice.

Wendell, B. *The France of To-Day.* Pp. 379. Price, $1.50. New York: Chas. Sribner's Sons. 1907.

Reserved for later notice.

Widney, Joseph P. *Race Life of the Aryan Peoples.* Two vols. Pp. xiv, 706. Price, $2.00 each. New York: Funk & Wagnalls, 1907.

A popular account, chronologically arranged, of the movements and developments of all the known Aryan peoples beginning with the old Asian home and tracing the history down even to the latest occupied habitats of the English-speaking peoples. There is practically no indication that there are involved serious questions of fact, on which students are by no means agreed, save in the discussion of the original seat of the Aryans. No authorities are quoted either in the text, footnotes or appendix. The author fully believes that the Aryan is the superior of all other races of men; that of all Aryans the English-speaking groups are, and will be the leaders, while the Americans are to be in the van in the centuries to come. A considerable part of the second volume is given over to superficial consideration of American problems and forecastings of future developments, such as the alliance of all English-speaking peoples and the extinction (or migration) of the negroes. The style of the volumes is bright, the narrative interesting, the facts of the migrations generally accurate. The reader will enjoy the book—the student will wonder where the author gets the evidence for his conclusions and will probably smile at his naïve philosophy.

Wood, W. A. *Modern Business Corporations.* Pp. xi, 358. Price, $2.50. Indianapolis: Bobbs-Merrill Co.

Reserved for later notice.

Wright, H. N. *A Handbook of the Philippines.* Pp. xvii, 431. Price, $1.40. Chicago: A. C. McClurg Co. 1907.

Reserved for later notice.

REVIEWS.

Barker, E. *The Political Thought of Plato and Aristotle.* Pp. xxii, 559. Price, $3.50. New York: Putnam's Sons, Importers, 1906.

A proper perspective of the political thought of the greatest two of the philosophers of Greece demands a review of the work of those who preceded them as well as that of their contemporaries. With this purpose Mr. Barker opens his book with a very clear discussion of the early Greek philosophers and of Socrates, the minor Socratics and the Sophists. The story as told is at once so simple and apparently complete that the reader is in doubt whether the subject matter at hand justifies so consecutive a treatment. Into the story, based on evidence, the author has woven the fruits of modern speculation and criticism upon his subject and the result is an attractive presentation of something which, stripped of the contributions of secondary writers, must always remain a hazy, fragmentary record of development. In a sense, therefore, the book is a discussion of the political thought about the Greek philosophers as well as a presentation of the theories actually attributable to them. With this qualification it is just to say that the work is admirably done.

To the political thought of Plato the author devotes three chapters, to that of Aristotle seven. The comparisons between the two philosophers will impress some readers as not always well chosen. Plato is considered above all a practical reformer, his writings were intended as projects for actual social reform. Aristotle was a speculative genius, a theorist interested rather in the co-ordination of all human knowledge than in the people around him. And again, "Aristotle wrote the 'Politics,' but Plato is the great political thinker of Greece" (p. 184).

There are numerous passages to which many political scientists would raise objection not only in criticism of the author's interpretation of his subject, but in some cases of his use of terms. An example of the latter is the following: "To Aristotle . . . citizenship means direct participation in the exercise of sovereignty. It does not mean as it means to-day, the right to share in the election of the sovereign." Is it true that citizenship, as at present conceived, means ability to partake in the choice of a sovereign? Most political scientists would surely, if forced to decide between the two definitions given, vote that the one ascribed to Aristotle is more in line with present thought than the one given by the author. Instances of this character could be easily multiplied.

But as a whole the book is a creditable production of an earnest scholar. Its style is excellent—it is much more readable than the average work dealing with political theory. Perhaps the best summary that can be made of the volume would be: It is a good book on theory which an average man can read.

Chester Lloyd Jones.

University of Pennsylvania

Cambridge Modern History. Volume X, The Restoration. Pp. xxix, 907. Price, $4.00. New York: The Macmillan Company, 1907.

The treatment of the nineteenth century by the "Cambridge Modern History" very naturally gives rise to new difficulties to editors and authors alike. Apart altogether from the difficulties arising from the nearness of the historian to the events he is treating and the consequent difficulties of obtaining a proper perspective, there is the problem of the enormous volume of the material, which is in the main unorganized, and which has not yet been subjected to critical examination by the trained historian. Under these circumstances the monographic plan of the Cambridge history has here even greater advantage than in previous periods. In a new field of history the work of the specialist is of greatest value, and it is therefore with particular expectation that students have awaited the volumes of this great historical work on the last century.

That the volume before us meets our expectations as fully as we had hoped, is not true. There are excellent monographs, with plenty of detail, often coupled with a broad grasp of the subject, and a power of interpretation that is very illuminating. Among these is the second chapter by Professor Bourgeois, the one on the "Orleans Monarchy," though one might

quarrel with the over-emphasis of ministerial history at the expense of a more extended treatment of the tantalizingly suggestive allusions to great economic and social changes. We are told of the practical legislation to aid the industrial transformation, of the laws concerning a system of French railways, education, internal communications, the army, etc., but not a word of the features of these measures. And surely these are of equal importance with the much discussed, but very doubtful influence of Louis Philippe in laying the basis of his rule. "With a happier inspiration than that of the Parliamentary party, who would have compromised everything by premature repression, Louis-Philippe had himself laid the foundation of his monarchy" (p. 484). But if Professor Bourgeois is a sinner in this respect, others are so to a much greater extent. The Congresses and the Eastern question are treated by W. Allison Phillips, whose special studies in this field give to his three chapters the stamp of authority. But there is too much made of negotiations and of the motives of individuals. Is it not time to emancipate the history of the nineteenth century from this undue emphasis of diplomatic relations? The very excellent chapter by Professor Clapham, of the University of Leeds, on "Economic Changes" is no excuse for the extremely political nature of the treatment of so many of the other chapters. Professor Clapham's contributions will be of especial interest to readers of THE ANNALS. The latter half of the chapter affords an excellent survey of the economic changes on the continent, corresponding to the industrial revolution in England. Of great interest and even more timely is the work of F. A. Kirkpatrick, M. A., in two chapters on "Spanish America," and the establishment of its independence. In the extended bibliography on these topics Professor Bourne's excellent work on Spain and America and Dr. Paxon's scholarly book on the Independence of the Spanish-American Colonies, are conspicuous by their absence. Mr. Bennian's short chapter (ten pages) on Canada would be of greater interest if it were not so much abbreviated. Of foreigners contributing, there are, besides Bourgeois, already mentioned, Professor Segrè, of the University of Rome, on Italy; Professor Altimira, of the University of Oviedo, on Spain; and Professor Askenazy, of the University of Lemberg, on Russia and Poland.

The history of the German Federation from 1815 to 1840, is well done by Professor Pollard, of the University of London, but there are curious omissions in the bibliography. For example, on the Zollverein we find no mention of source material, not even for the text of the law and the treatise. This is the more conspicuous because of the report made by Mr. Bowering to Parliament in 1840, giving in translation nearly all the important documents on the question. Mr. Temperly, Fellow of Peterhouse, not "of fellow Peterhouse" (p. xx), gives what seems to me an able presentation of a well-known period of English history from 1815 to 1833. The first half of the treatment reveals an intimate knowledge of the foreign policy. Mr. Gooch, of Trinity College, continues the account to 1841 in a good chapter on Great Britain and Ireland. The chapters on the literary movements, one on "Literature in Germany," the other on "The Revolution in English Poetry and Fiction," are novel features of the volume, but of

greater interest to the readers of a journal of politics and economics is the chapter of Professor Nicholson, of the University of Edinburgh, on "British Economists."

William E. Lingelbach.

University of Pennsylvania.

Casson, Herbert V. *The Romance of Steel.* Pp. xiv, 376. Price, $3.50. New York: A. S. Barnes & Co., 1907.

The character of this book is best told in the words of the author's preface—"the first popular history of our greatest American industry." "The wonderful story of steel," continues the author, "is here told in such a way that those who have no technical knowledge of steel making may enjoy and appreciate the miracles that have been accomplished." Though written "after the manner of fiction, the facts have been gathered from the highest authorities."

The rise of Carnegie, Frick, Phipps, and a dozen other steel magnates, the story of the Superior ore ranges and the tales of Pueblo and Birmingham are chapters which will appeal to everyone who ever saw a steel rail or a blast furnace.

The book is all that the author claims for it. It is decidedly readable, despite an occasional complication of biographies. The title, however, may prove misleading. The person seeking a scholarly, or even complete, history of the iron and steel industry in this country will certainly be disappointed at the brief mention accorded the early history of iron making. Less than ten pages out of nearly 400 are allotted to the iron industry from 1622 to 1847. Briefer biographies of some of the "thousand millionaires" could have made way very profitably for a more thorough historical setting. A millionaire is said to have a fascination for the average American mind, but at times Mr. Casson's eulogies detract from, rather than add to, the value of the book from the standpoint of interest in steel and its history.

The volume is essentially a history and eulogy of the United States Steel Corporation, or, as we read in one place, "a story of money makers." Mr. Casson appears to have nothing but commendation for this gigantic industrial combine and its individual members. The final chapter forecasts a glowing future for steel in every field of activity, as glowing as could be expected from the most optimistic operator himself. The book is to be heartily recommended to all who would know the manner in which America's greatest industry came to be controlled by a relatively small group of men. The commercial, industrial, social,—in fact the entire body of the economic relations of the steel business are barely touched, the "money makers" and the "thousand millionaires" evidently having proved the more engrossing part of the romance.

Walter Sheldon Tower.

University of Pennsylvania.

Doyle, John A. *English Colonies in America.* Volume IV, The Middle Colonies; Volume V, The Colonies under the House of Hanover. Pp. xxxii, 944. Price, $3.50. New York: Henry Holt & Company, 1907.

The appearance of the final volumes of Mr. Doyle's history of the English colonies in America marks the completion of a work the first volume of which was issued a quarter of a century ago. The author's death, following within a few months of the publication, awakens a peculiar interest in these volumes and naturally suggests a brief résumé of his work on American history. Probably no Englishman of his generation has evinced greater interest in American colonial history or written so extensively in this field. His earliest work, the Arnold prize essay at Oxford dates back to 1869. In addition to his chief work, and his frequent notes and reviews of books on American history in the *English Historical Review*, his most notable contribution is the chapter in the seventh volume of the "Cambridge Modern History" on the American colonies. It would appear, however, that Mr. Doyle pursued historical work as an avocation, a mere incident of his life as a gentleman farmer and sportsman.

Of his earlier volumes in this series, the first was devoted to the Southern colonies from their settlement to the close of the reign of Queen Anne, and the second and third to the New England colonies during the same period. While his pages were frequently marred by minor errors, in general his narrative was regarded as trustworthy and as presenting in the main a true picture of the times.

Finally, after an interval of more than twenty years, a period so long in fact, that it was supposed by many that Mr. Doyle had permanently abandoned his task, the concluding volumes were finished. The student of colonial history will be curious to note whether the new volumes reveal a more mature scholarship and a firmer grasp upon his subject.

It may be said at the outset that Mr. Doyle has followed the same general plan as in his earlier volumes. In Volume IV the Middle Colonies are treated up to 1714, in conformity with his history of the Southern and New England Colonies. Six chapters of this volume, or about two-thirds of its contents, are devoted to New York, two to New Jersey and a single inadequate chapter is allotted to Pennsylvania. The final volume covers the colonies under the House of Hanover from 1714 to 1760. Here, instead of adhering to a continuous narrative of the colonies according to their geographical grouping, Mr. Doyle essays to consider the colonies as a whole, treating their history topically in chapters dealing with special subjects, such as the general condition of the colonies at the opening of the period, their administration, their economic progress, their religious, literary and educational development. The volume concludes with a careful account of the colonization of Georgia and a summary of the events of the French and Indian War.

While Mr. Doyle's treatment of the Middle Colonies is fairly systematic, it follows traditional lines and is not based in all cases on the latest authorities. Its proportion is open to criticism, and like the early volumes, the strict adherence to a geographical classification precludes any scientific or

thoroughgoing comparison and study of colonial institutions, so necessary to an understanding of later American constitutional history.

The final volume is the least satisfactory of the set. In his attempt to treat the colonies as a whole the author fails to acquire a continental grasp, and contents himself with a topical narrative along conventional lines which at best is very incomplete. One especially misses any systematic account of the development of British imperial policy and the administrative control of the colonies. To illustrate, there is no adequate discussion of the navigation acts, or the commercial policy of Great Britain. The functions and manifold activities of the board of trade are not presented. The increasing interference of Parliament and the executive department of the British government in the internal affairs of the colonies is not sufficiently brought out. Narratives of the conflicts between the colonial legislature and the royal and proprietary governors are given, but there is no clear presentation of the general policy of the imperial government. This neglect is the more surprising and disappointing in view of the emphasis which has been placed upon these phases of colonial history by recent American authors.

It is apparent that these obvious omissions are due in part to Mr. Doyle's adherence to the older view of the scope of colonial history. His source material while good, has been inadequate. He has relied upon the older standard histories, such as Broadhead's New York and Proud's Pennsylvania, together with the published records of the several colonies, and to a limited extent upon the printed volumes of the Calendar of State Papers, but only in rare instances has he consulted manuscript archives.

In addition to other shortcomings the author's work is marred by a decided inaccuracy of detail. There are also many instances of carelessness and lack of consistency in the citation of references in the footnotes. A few examples of some of the most conspicuous of these errors must suffice. American geography, so troublesome to English writers in general, has proved to be none the less so in this case. Thus we are informed that the Piscataqua separates New Hampshire from Massachusetts; that Onondaga county is the district which is now Vermont, that the New York-Connecticut boundary line lies twenty miles north of the Hudson, that Flatbush is at the southeast end of Long Island, that Elizabethtown is located on the Delaware. New Netherland is invariably spelled New Netherlands. The celebrated Philadelphia lawyer, Andrew Hamilton, is referred to as Alexander Hamilton; and Jonathan Belcher is incorrectly named Andrew. To the colony of New York is erroneously given the credit of having first asserted the right of self-taxation. The Pennsylvania Charter of Privileges of 1701, we are told, made no modification of any constitutional importance, although in fact it changed the whole status and character of the council in its relation to the assembly.

With all their shortcomings these volumes possess many redeeming qualities. They contain a readable narrative of facts, impartially presented and frequently enriched by well considered judgments and reflections. Mr. Doyle has been happy in his characterization of men, as instanced in his realistic pen portrait of Stuyvesant and his sympathetic estimate of Penn.

Viewed as a whole these volumes present an essentially truthful, although not a complete, account of the internal development of the colonies. Their chief deficiency is in their failure to adequately present their history in relation to the rest of the empire. The final judgments of Mr. Doyle's history, we believe, will pronounce it a highly useful but not a scientific and indispensable work.

HERMAN V. AMES.

University of Pennsylvania.

McBain, H. L. *DeWitt Clinton and the Origin of the Spoils System in New York.* Pp. 161. Price, $1.50. New York: Macmillan Company, 1907.

The name of DeWitt Clinton is usually connected with all that is debasing and corrupt in the distribution of patronage in New York. With his advent to power in the politics of his state by the turn of fortune in 1801, he is charged with cleaning all the offices of federalists to make way for republicans, that for his own self-interest the adherents of rivals within his own party were excluded, and that he was guilty of nepotism. From such imputations it is the express purpose of this paper to clear the name of DeWitt Clinton. It is a curious fact that at least half a dozen scholars and historians of eminence and ability have uttered these charges without any regard to the story the source material might tell. And this source material has not been inaccessible.

This monograph is based on the manuscript files and minutes of the council of appointment in whose hands lay the patronage of New York, also on the public papers of both George and DeWitt Clinton, on the legislative journals with a judicious use of contemporary newspapers and pamphlets. To show what precedent there was and to what extent DeWitt Clinton departed from precedent, an account is given not only of the history of civil service in the state prior to 1801, but also in the national government.

The writer clearly shows by adequate evidence that in both state and nation "every feature of DeWitt Clinton's plan of parceling out the patronage of the state found some authority in the practice which had preceded him" (p. 13). In New York State the federalist council of appointment under Governor George Clinton practiced a policy of exclusion toward opponents and a similar policy was adopted when the federalists rose to power under Jay in 1795. In 1801 the republicans were victorious in both state and national elections only to find all the offices in the hands of their political opponents. It was inevitable that with a change of party should come a change in office holding. DeWitt Clinton practiced no new system in using the patronage for party ends. It had been an inveterate practice of English politics.

Further, the evidence plainly shows that DeWitt Clinton did not exclude all political opponents. His policy was to grant the larger offices to republicans, and to divide the smaller between the parties in proportion to their respective numbers, and this plan was put into practice. Neither did he exclude the adherents of Burr, but places were found for some of this rival's closest adherents. On the charge of nepotism it is curious to note

the writer shows that in every case where his relations held office, it was by election and not by appointment. Besides setting the fame of DeWitt Clinton in a new light, the monograph is also valuable as giving a splendid account of the early development of civil service in both national and state government. In point of style and lucidity the writer is to be commended. It is readable, a quality which cannot always be predicated of a doctoral dissertation.

Winfred Trexler Root.

University of Pennsylvania.

Osgood, H. L. *The American Colonies in the Seventeenth Century.* Vol. III. Pp. xxii, 551. Price, $3.00. New York: The Macmillan Co., 1907.

In the first two volumes, which appeared several years ago, Professor Osgood related the story of the plantation of the colonies and of their development to a period near the close of the seventeenth century. He took particular pains to distinguish between the corporate and proprietary form of colony, making the distinction clearer, perhaps, than any previous writer had done. The sub-title of the present volume, "Imperial Control," indicates that the point of view now shifts to the other side of the sea.

The first chapter is devoted to the organs of imperial control. In point of law there was no distinction between the realm and the dominions, but the differences in fact were very great. Newly discovered lands vested in the crown, hence the regulation of colonies seemed to be a matter of prerogative. On the other hand, Parliament, being jealous of the prerogative, was some times disposed to take a part, but did not in fact pass more than half a dozen laws for the colonies during this period, and these related to trade. The colonists, acknowledging submission to the mother country, were between two fires. If they denied the prerogative of the crown, they were in danger of falling under the dominion of Parliament.

The development of the imperial system was somewhat slow and irregular. For this there were two reasons, the remoteness of the colonies, and the irregular method of their plantation; and the disturbances in English politics. But, throughout it all the influence of the mercantile idea, that colonies must subserve the material interests of the mother country, is unmistakable. Gradually the policy of bringing the colonies under one system, that of the royal province, and of unifying the control, began to develop. This was not, as some historians have maintained, merely a part of the Stuart policy to rule arbitrarily so much as a matter of convenience in enforcing the trade regulations at the entreaty of the London merchants. The trade acts were not altogether inimical to the colonies, but on the whole, they would have been detrimental if rigidly enforced. The crucial test came in the attempt to consolidate New York and New England and enforce the acts there. But the Stuart throne was already tottering, and with its fall the imperial system for the colonies practically collapsed for the time being.

Nearly all historians state that the trade acts were not designed to

raise a revenue, yet they fail to state into what exchequer the incidental revenue was to flow. It is gratifying to note that Professor Osgood has brought this out in the course of the narrative. The reader will find many other details also, some of which are less interesting, but, on the whole, this and the two preceding volumes make a really notable contribution to our colonial history.

DAVID Y. THOMAS.

University of Arkansas.

Ross, Edward Alsworth. *Sin and Society.* Pp. xi, 167. Price, $1.00. Boston: Houghton, Mifflin & Co., 1907.

In gathering together the brilliant essays that he has been contributing to the *Atlantic Monthly,* Professor Ross gives us one of those rare books that are really worth while. "New Varieties of Sin," "The Criminaloid," "Sinning by Syndicate"—no one who enjoys clear thinking and vigorous writing can afford to miss these stimulating chapters. "The founder of the Oil Trust may give us back our money, but not if he send among us a hundred Wesleys can he give us back the lost ideals." Thus does the author epitomize the moral havoc wrought by the gospel of success as preached in Big Business. Everyone admits the wickedness of the old personal sins,—lying, cheating, stealing, killing by violence; but public indignation is not yet sufficiently kindled against the franchise grabber, the food adulteror the exploiter of women and children, the neglectful railroad red with the blood of employees and passengers. Their guilt is impersonal, yet it shakes the very foundations of social order; and as Professor Ross protests vigorously, it is against such sins and not simply against personal vices that the thunderbolts of public wrath need to be directed. We could wish that he had laid more emphasis on publicity of great business affairs as a means of making public opinion effective; but one ought not to find fault with so good a book. It well deserves the wide influence invoked for it in the interesting prefatory letter of President Roosevelt.

H. R. MUSSEY.

University of Pennsylvania.

Schuster, E. J. *The Principles of German Civil Law.* Pp. xlvi, 684. Price, 12*s.* 6*d.* Oxford: The Clarendon Press, 1907.

This is an important contribution to the literature of comparative legislation. Mr. Schuster has compressed within less than seven hundred pages a clear discussion of the latest and greatest attempt made by any nation to codify the entire body of substantive law, and has combined with this discussion a comparison with the English common law wherever the contrast or similarities were so striking as to make such a course of particular value. The book is so arranged that besides rendering this service to the student of comparative law it is also available for use in that numerous class of cases arising out of the rapid expansion of international relations as they

affect the individual. The contrast of continental and English law is brought out in such a way that misunderstandings can be made less frequent and cases of the conflict of laws can be more easily adjusted. These comparisons are carried through the whole field of law, bringing out the differences of practice—to illustrate with examples—upon the validity of marriages, the effect of marriage on property, the rules as to settlements and trusts, the nature and effect of wills, etc.

Mr. Schuster is to be congratulated upon the care taken in the nomenclature used. Evidently no pains have been spared to get exact translations of the terminology of the codes, and where no English equivalent is available the distinction between the similar English word used and the German word is always carefully brought out. This has been by no means an easy task, for the language of the codes is so highly technical that exact translation is often all but impossible.

A short historical sketch preceding the main discussion gives an idea of the chaotic condition of German state law, which was superseded by the imperial legislation culminating in the adoption of the code in 1900. German private law now consists chiefly of the civil code and the commercial code, both of which overlap so that both must be consulted to find the law on any subject. In turn they are rounded out by numerous additional statutory supplements. The ground work of the codes is the Roman law with additions from the "common law" developed in Germany, and other provisions of entirely modern character. So far as possible the language used is simple, though the intent has not ruled the outcome as much as was hoped. The methods of expression and interpretations adopted, it is claimed, admit of adaptation to new conditions, thus obviating the stock objection to a code as a body of "dead law." But no doubt this wide margin, now left to judicial discretion, will gradually disappear and the decisions will build up a new customary law. This, however, should not blind us to the fact that though not a work of permanence, codification works for the definition of principles as opposed to the casuistic irregularity so often fostered by the absence of any co-ordinated body of law.

CHESTER LLOYD JONES.

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Small, Albion W. *Adam Smith and Modern Sociology.* Pp. ix, 247. Price, $1.25. Chicago: The University of Chicago Press, 1907.

This book is a fragment of a more complete study of the relations between nineteenth century social sciences and sociology, according to a statement in the preface. This first volume undertakes to prove the following thesis: "Political economy, as viewed by Adam Smith, was the technology of a practical art which was strictly responsible to a moral philosophy that correlated all human activities. Political economy, after Adam Smith, lost its sense of connection with the large moral process, and became the mystery of the craft of the capitalizer. We propose an inspection of Adam Smith's economic system, for the purpose of showing that in his mind there was no

antithesis, still less a divorce, between economic technology and sociology; and that the organization of the two in his philosophy rested upon a general conception of the subordinate relationship of all specific activities within an inclusive moral system, to which, in effect, though not in detail, all students of society must ultimately return."

Probably most careful students of Adam Smith, taking account of the "Theory of Moral Sentiments" as well as the "Wealth of Nations," will admit that the great apostle of individual liberty was first a moral philosopher, and only secondarily an economist. This idea Professor Small develops in his own peculiar terminology, making abundant citations from the "Wealth of Nations." Adam Smith's social, or as our author prefers to call it, sociological point of view, is contrasted with that of the classical economists, who were so intent on increasing production as to forget that more wealth is worth while only as it means increased welfare, and that welfare depends quite as much on just distribution as on increased production.

The most interesting chapter in the book is that on "The Economics and Sociology of Labor," which contains a suggestive criticism of Adam Smith's use of the slippery word "natural," and our use of the equally elusive "normal." To assume that competition or the private ownership of land and machines, or any particular feature of the present system of distribution, is "normal," is to incur the danger of the question-begging epithet, no matter how carefully one may define his terms. Professor Small maintains that there is a fundamental difference between claims to material goods based on labor, and claims based on conventionality, the former being essential, the latter only institutional. We are unable to agree that labor itself constitutes a valid claim to income, as the argument of the book seems to indicate. Income from labor, no less than that from property, must justify itself on the ground of social utility.

To return to the argument of the book, economics is a purely technological discipline, judging conduct solely with reference to its effects on wealth. It furnishes an indispensable part of the data for that larger moral judgment which it is the special province of the sociologist to make, and which has for its criterion social welfare or progress. The claim advanced for sociology is not a particularly new one, but it is presented in a rather striking fashion. If one may judge at all by the recent literature of economics, however, the economists have no idea of letting themselves be shut up within the narrow bounds here laid down. Dispute as we may over names, the cheering fact remains that we are all beginning to study the social sciences from the viewpoint of human welfare.

H. R. Mussey.

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Smith, Samuel G. *The Industrial Conflict.* Pp. 217. Price, $1.00. New York: Fleming H. Revell Company, 1907.

This study, by a member of the department of sociology in the University of Minnesota, is said by its author to differ "from all that has been written

upon the question, in that it is not based upon a theoretic, but a real world, and, instead of seeking to serve some theory, endeavors to show the actual grounds upon which the whole subject rests, and, rejecting both matters of method and incidental questions, to set in a clear light the issues involved" (p. 8). Two chapters consist of reprints of letters received from labor leaders and employers. In the discussion of these letters, the author emphasizes many of the elementary truths of political economy in a readable manner, and even for those who have some acquaintance with the literature of the labor question, it may be convenient to have the demands of employers and employed brought together in one place. In the chapter on the "Three Parties in Interest" it would have been well to analyze the concept of "the public," viewed as a distinct group from employers and employed. In the final chapter socialism is judged adversely. Dr. Smith asserts that under socialism the management of industry would be either by a caste system the worst the world has ever known or else by the general average of intelligence, which would check production. There would be no incentive to the individual to put forth all his powers. Finally he rejects socialism because it is an assault on the family and is anti-patriotic. The attempted distinction between political and economic socialism is not clear.

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Speed, Thomas. *The Union Cause in Kentucky.* 1860-1865. Pp. xv, 355. Price, $2.50. New York: G. P. Putnam's Sons, 1907.

No part of the history of the Civil War is more deserving of investigation than that played by the border states. Up to the present time, however, the internal history of these states has been inadequately presented, especially the part played by the Union men in keeping these states from joining the Southern Confederacy.

It is with these convictions that Captain Speed has prepared the present volume. While much has been written to celebrate the deeds of those Kentuckians who went into the Confederacy he believes that the services of the Kentucky Unionists have been underestimated and misrepresented. The truthfulness and fairness of the author's account is testified to by Justice John M. Harlan, of the United States Supreme Court, in an appreciative introduction. Both Justice Harlan and the author call attention to the fact that even as able and unprejudiced a writer as the late Professor Shaler, of Harvard, in his history of his native state has gravely erred and given currency to a gross misconception, when he wrote that "the Blue Grass region sent the greater part of its men of the richer families into the Confederate army, while the Union troops, . . . came in greater abundance from those who dwelt on thinner soils," and that the former were as a whole, "a finer body of men than the Federal troops from the commonwealth." Captain Speed refutes this statement in Chapters VI and XI by marshaling a long list of Union leaders from prominent families and by a comparison of the records of the Union and Confederate troops from

Kentucky. The author claims to have drawn his facts from documentary sources, and an examination of his references seems to confirm his statement. In some respects, however, the work does not meet the expectation aroused by the preface. Instead of being a well-balanced continuous history, it consists of a series of chapters of a more or less fragmentary character, and some times introduces matter that is hardly germane to the subject. About two-thirds of the volume is devoted to the opening year of the war, and there is no consecutive account of either the military or civil affairs within the state during the remaining years of the period. We especially regret the omission of a review of the attitude of Kentucky on the abolition of slavery.

The absence of an index and the citation of references in the text are decided blemishes in the make-up of the volume. Captain Speed's work, while not comprehensive, corrects several misconceptions and throws important side lights upon some hitherto neglected phases of the history of perhaps the most important of the border states.

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